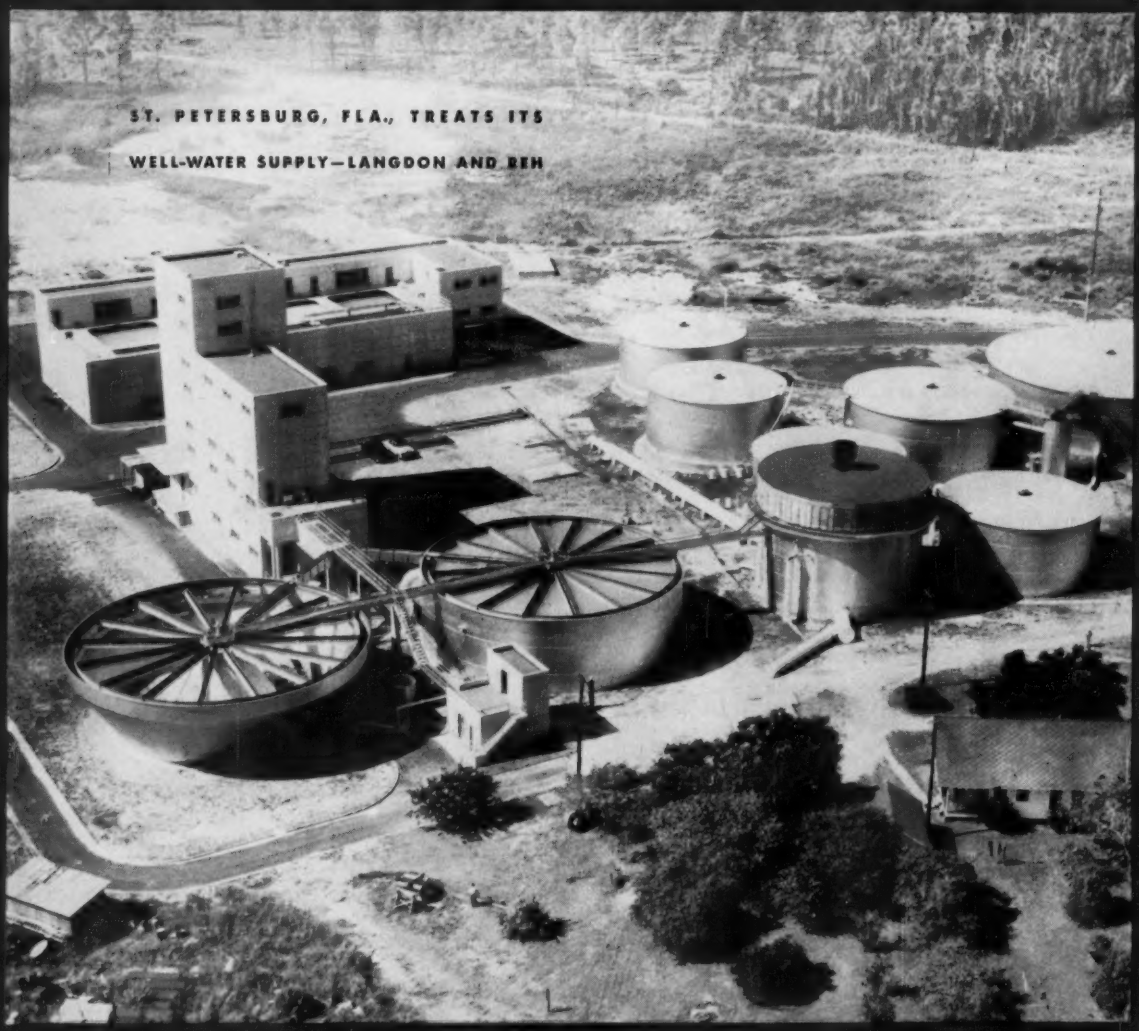
CIVIL ENGINEERING

APRIL 1956

THE MAGAZINE OF ENGINEERED CONSTRUCTION



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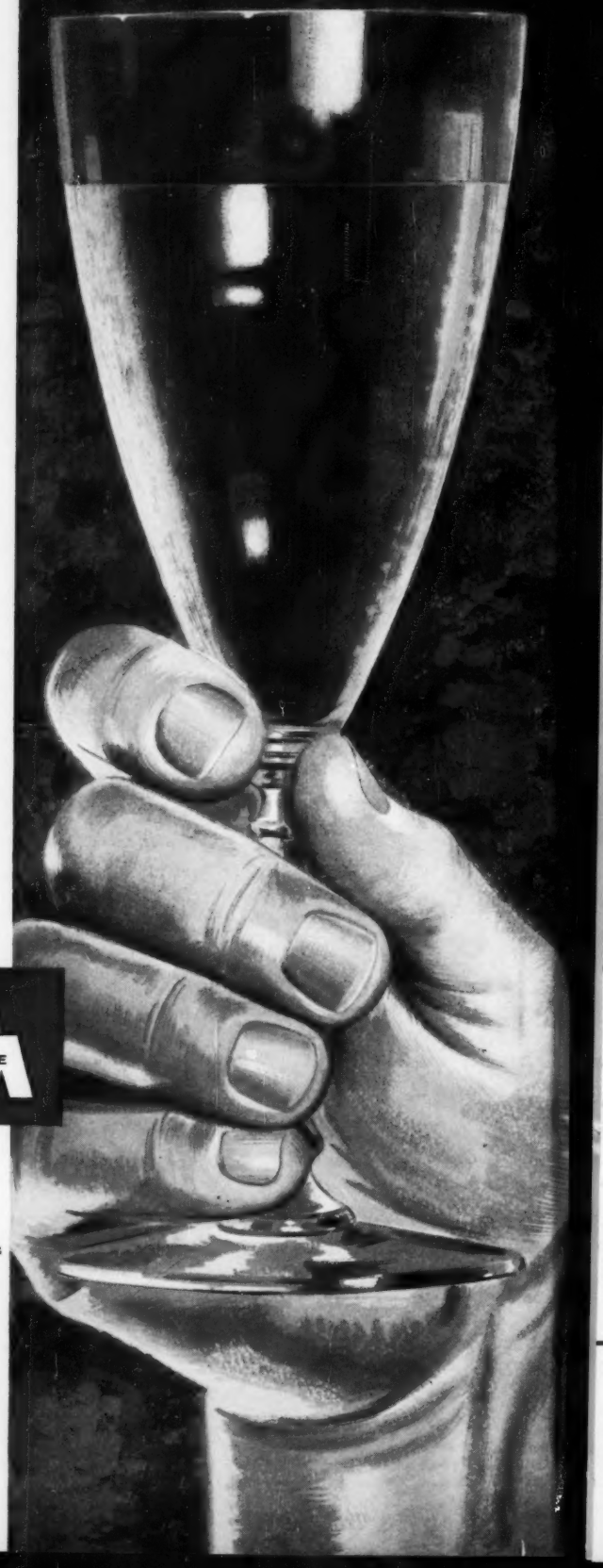

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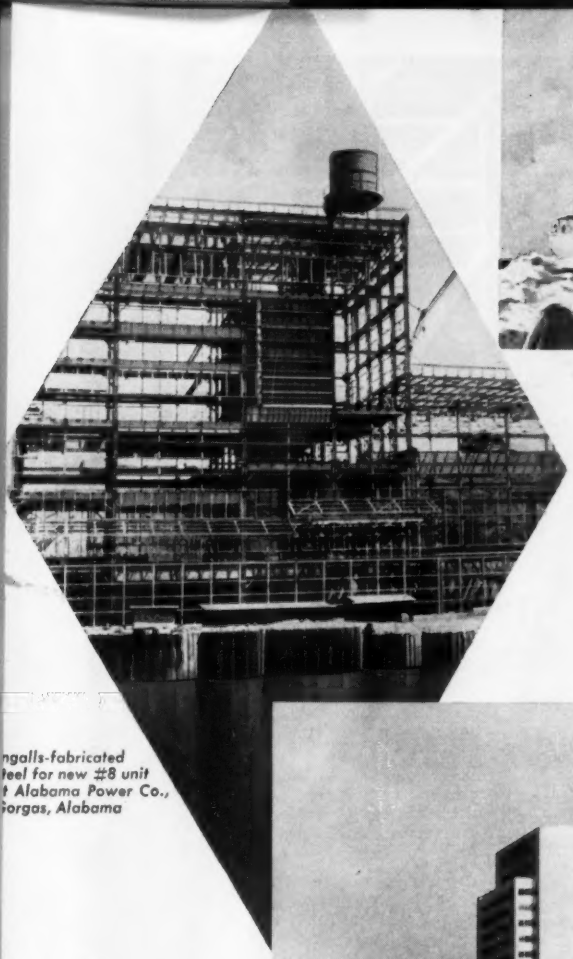

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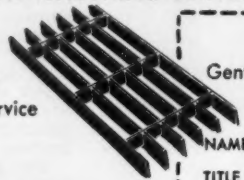

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VOL. 26 • NO. 4

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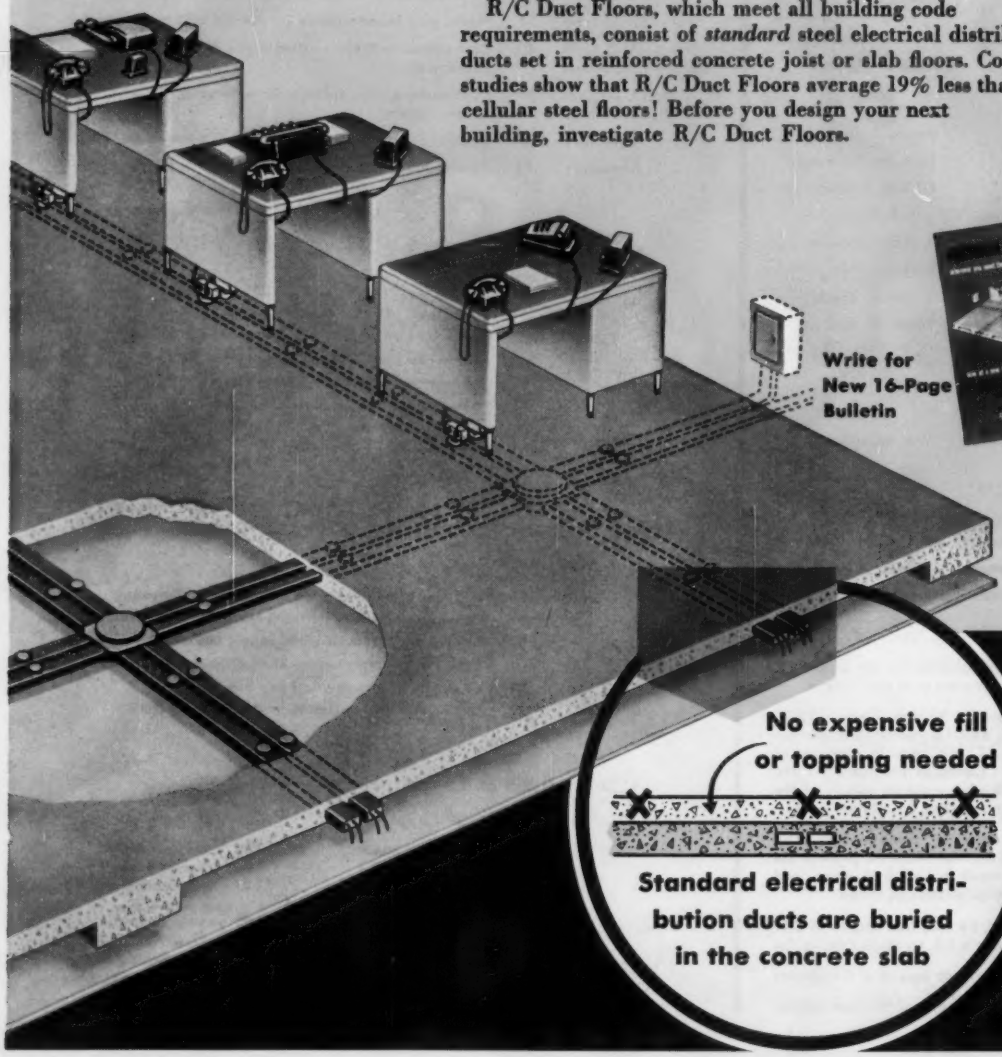

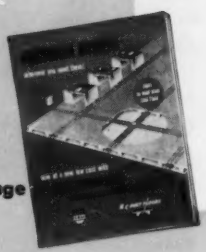

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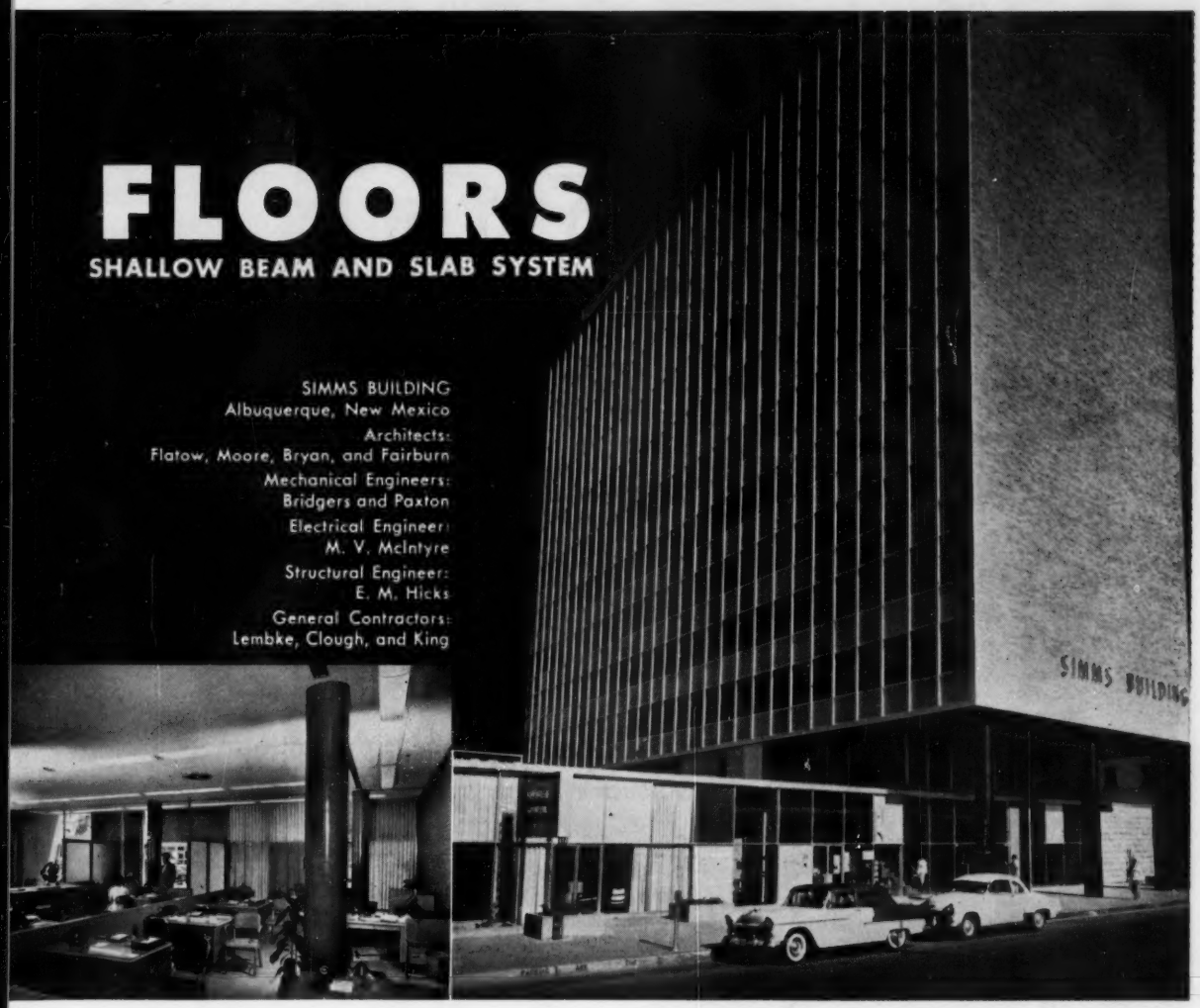

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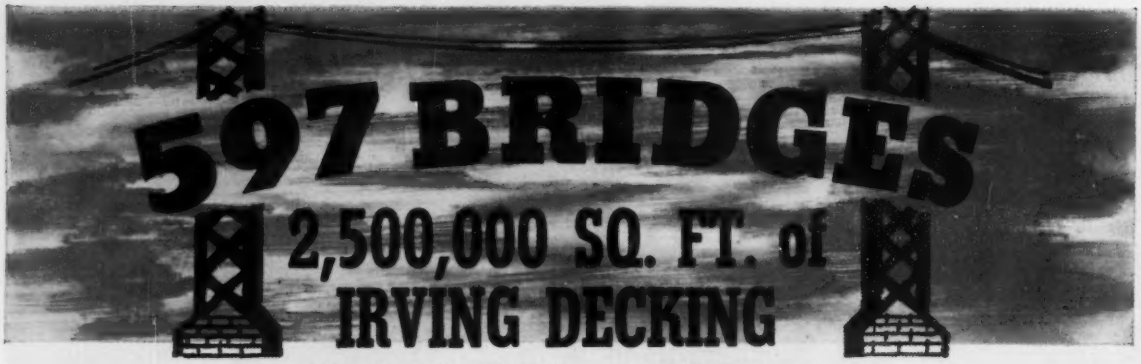

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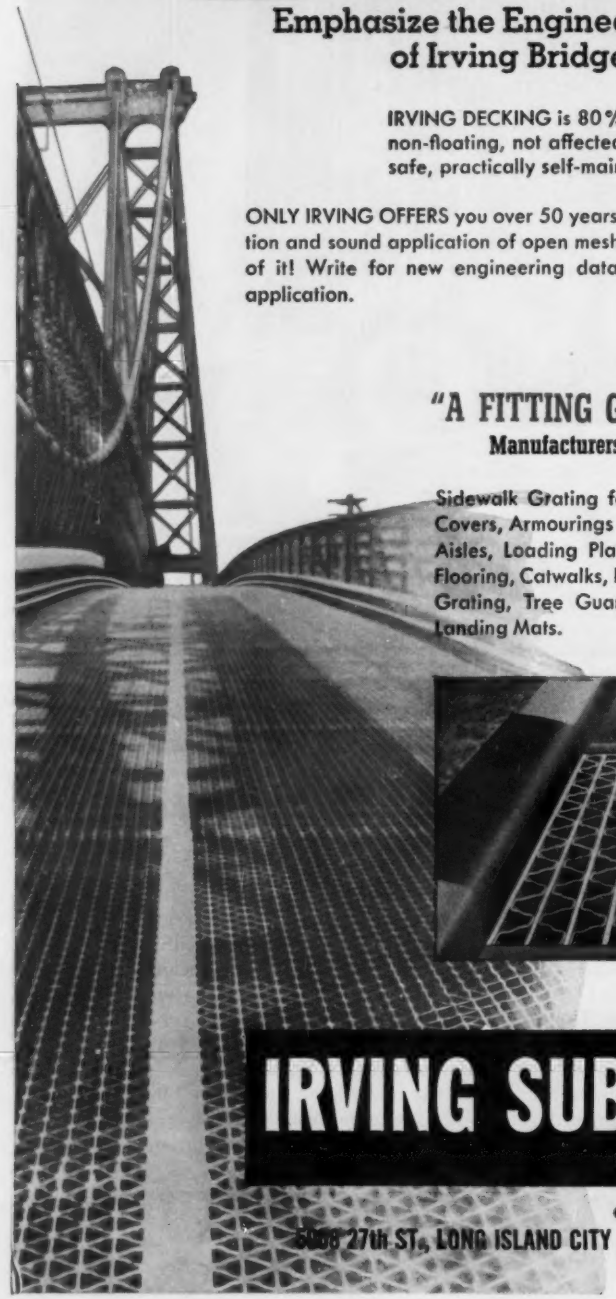

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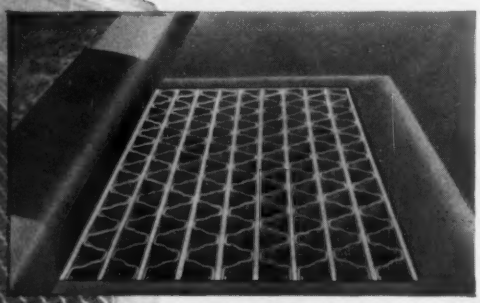

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JOBS on the move

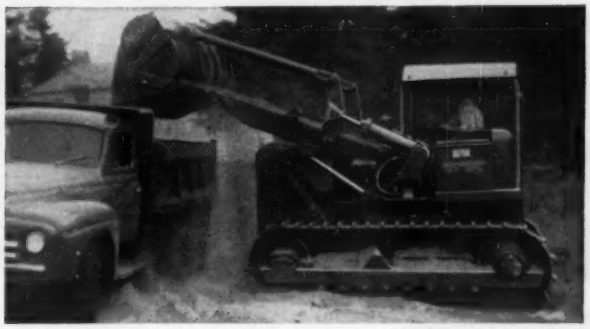
New design, outstanding features of Allis-Chalmers HD-11 Tractor and HD-11G Tractor Shovel help step up output on all kinds of work

Dozing and excavating in Paradise Valley, Pa., this HD-11 dozer-tractor is working on the job of replacing and relocating parts of a township road washed out in floods. The unit, owned by S. R. Nauman and Sons, Cresco, Pa., is shown here dozing out part of the 2,000-yd excavation, preparing grade for placing 10,000 tons of crushed stone base.

Grading, stripping and stumping are some of the jobs handled by this HD-11 Tractor with hydraulic bull-dozer blade. The unit, shown here stripping a gravel borrow pit for fill on roads, is owned by Atlantic County in New Jersey. There's a full program of work for the tractor — snow removal in winter and general maintenance on 390 miles of road the rest of the year.

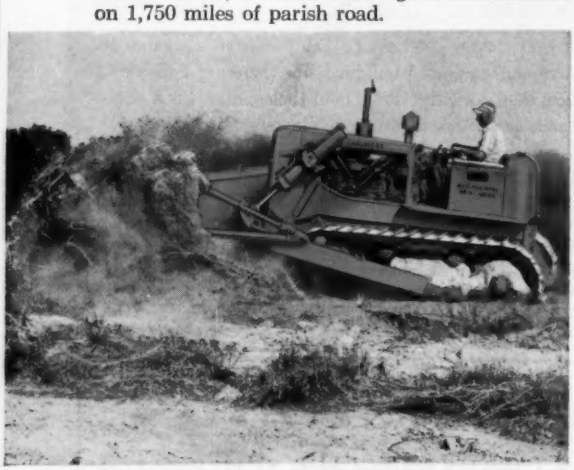
Clearing and skidding on a logging operation is the full-time job of this HD-11 Tractor. Equipped with a canopy and dozing blade, the unit is working in Deschutes National Forest for Lundgren Lumber Co., Bend, Ore.

Excavating and stockpiling topsoil for a new athletic field in Bel Air, Md., this HD-11 Tractor with bulldozer is on the job about 50 hours a week. The owners, T. & T., Inc., Whiteford, Md., use the tractor to strip topsoil, grade area, replace topsoil and landscape. About 28,000 yd of excavation will complete the job.



Excavating and dirt moving on a 12,000-yd job for a service station location is speeded by this HD-11G tractor shovel. The new unit is one of a fleet of five Allis-Chalmers tractors owned by Bass Construction Co., Seattle, Wash. A new Allis-Chalmers engine, 105 net engine hp, provides plenty of power and handles hydraulic requirements with ease.

Road building and maintenance in Franklin Parish, La., get an assist from a new HD-11 tractor-bulldozer. The unit is at work widening 40 miles of farm-to-market road near Wisner. Later, it will aid with regular maintenance on 1,750 miles of parish road.



Scraping and dirt moving for Don L. Builders, Inc., Kansas City, Mo., this HD-11 Tractor and 7½-yd Allis-Chalmers scraper combination moves 15 yd every sixteen minutes on a 300-yd haul. Operator Ralph Alewel states, "This tractor has plenty of power. I'm running in third gear most of the time. The unit is much more comfortable than any I've been on."

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CONTRACTOR: G. H. Lindekugel & Sons Construction Co.

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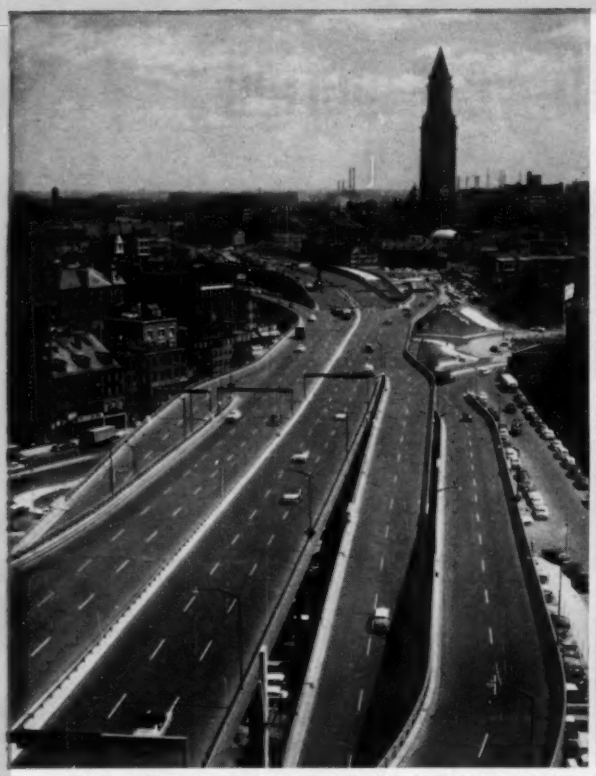
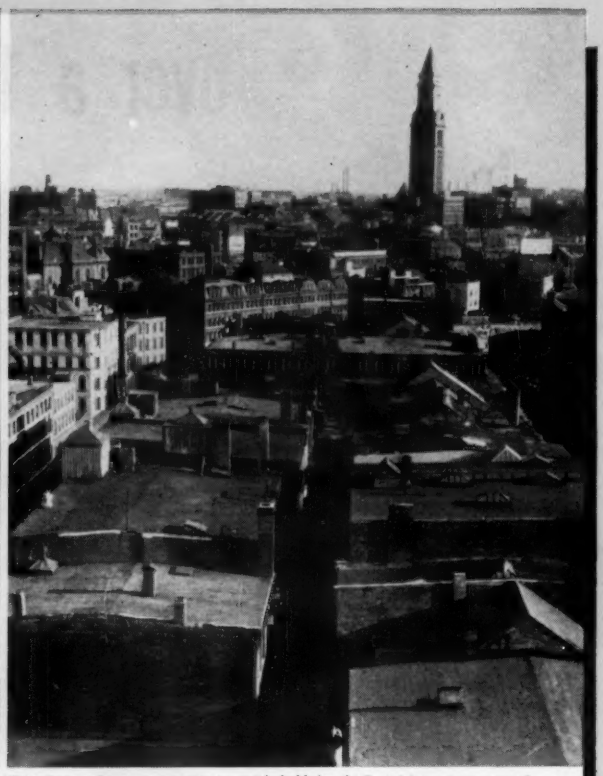


Boston's new Central Artery, seen from the Mystic River bridge, handles 120,000 vehicles daily.



This is the same downtown area of Boston, as it looked before the Central Artery was constructed.

8 minutes from home... or 40?

Here's how Massachusetts gives Thomas Johnson more time with his family—less time on the road. What's traffic like in your state?

Thomas Johnson works at an office on Washington Street, in the heart of downtown Boston. He lives in Chelsea, five miles away. Before the new Central Artery was built, the trip took 35 to 40 minutes' driving time each way in nerve-wracking traffic. Now he does it easily in eight minutes. He has nearly an hour more at home!

Boston used to be known as the worst traffic bottleneck in America. Old streets, narrow and twisting, plus a huge concentration of industry in a small area, made the Bay State capital a motorist's nightmare. Today, thanks to a farsighted policy of spending state highway funds where they are most needed, Boston is a different city.

It took courage and cash to tear through whole city blocks and build the Central Artery at a cost of $37,000,000 for a single mile. But since 70% of all traffic in the commonwealth originates or has its destination in Boston, voters recognized the vital need and supported the required bond issues. Meanwhile the other 2500 miles of state highways are not being neglected. Massachusetts has spent $285,000,000 for road improvements in the past four years, and even larger outlays are planned for the future.

Good highways *save* more than they *cost*—in time, in lives and in actual cash. They are the lifeblood of business and industry. If you want to know what *you* can do to help the road program in your own state, write today for the free booklet, "Road Block." Just mail a card to Dept. 2, Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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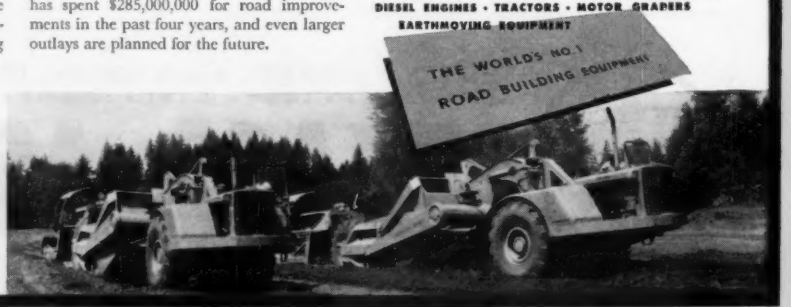
EARTHMOVING EQUIPMENT

Wherever you see Caterpillar machines working on your roads, you can be sure your state is getting its money's worth.



Equipment that BUILDS them

The advertisement on the opposite page appeared in full color in *The Saturday Evening Post,* in February. It is the latest of a series of hard-hitting messages on highway building—the longest and strongest continuous magazine campaign sponsored by any advertiser to promote better roads.

The evidence of hundreds of letters from *Post* readers shows that this advertising *is helping to stir up needed legislation—get roads built—produce construction contracts.*

Caterpillar is creating opportunities for you. And it's matching those opportunities with new and improved equipment to help you increase profits and cut costs. You've seen the results of constant research and development in the past year. Look at the array of modern Caterpillar track-type and wheel Tractors, Traxcavators*, Motor Graders, Engines and Electric Sets – all built to do more work for you, faster and at lower cost!

A good example of Caterpillar leadership is the new CAT* DW21 Tractor (Series C) with its matching No. 470 LOWBOWL Scraper. A 300 HP Caterpillar Engine with Turbocharger gives the tractor increased rimpull. New, big, wide-section tires add to flotation and traction. And there's optional electric or gasoline starting. New LOW-BOWL construction of the scraper permits loading 18 cu. yd. struck or 25 cu. yd. heaped—faster, more easily than old scraper designs. In on-the-job tests these rigs consistently move more earth in faster cycle-times than competitive equipment.

Caterpillar—and your Caterpillar Dealer—are your partners in progress.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

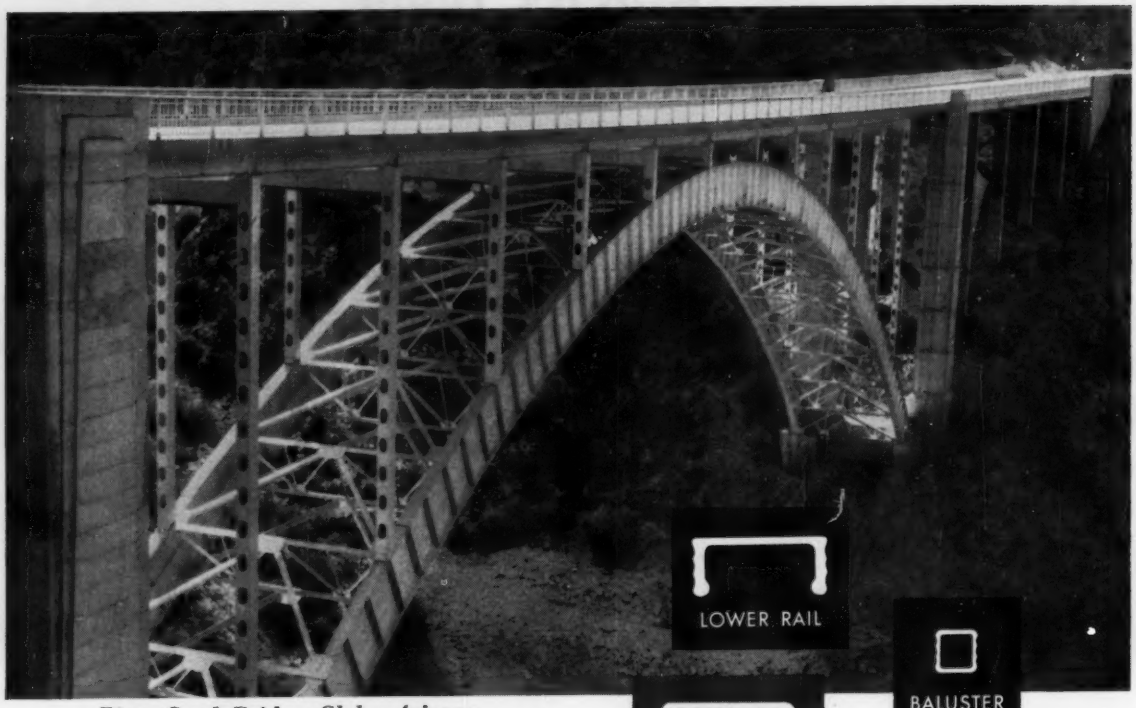
CATERPILLAR*

*Caterpillar, Cat and Traxcavator are Registered Trademarks

LEADERSHIP IN ACTION

High Proof of Performance . . .

ALUMINUM BRIDGE RAILINGS



Pinto Creek Bridge, Globe, Arizona

Engineers:
Arizona Highway Dept., Bridge Division

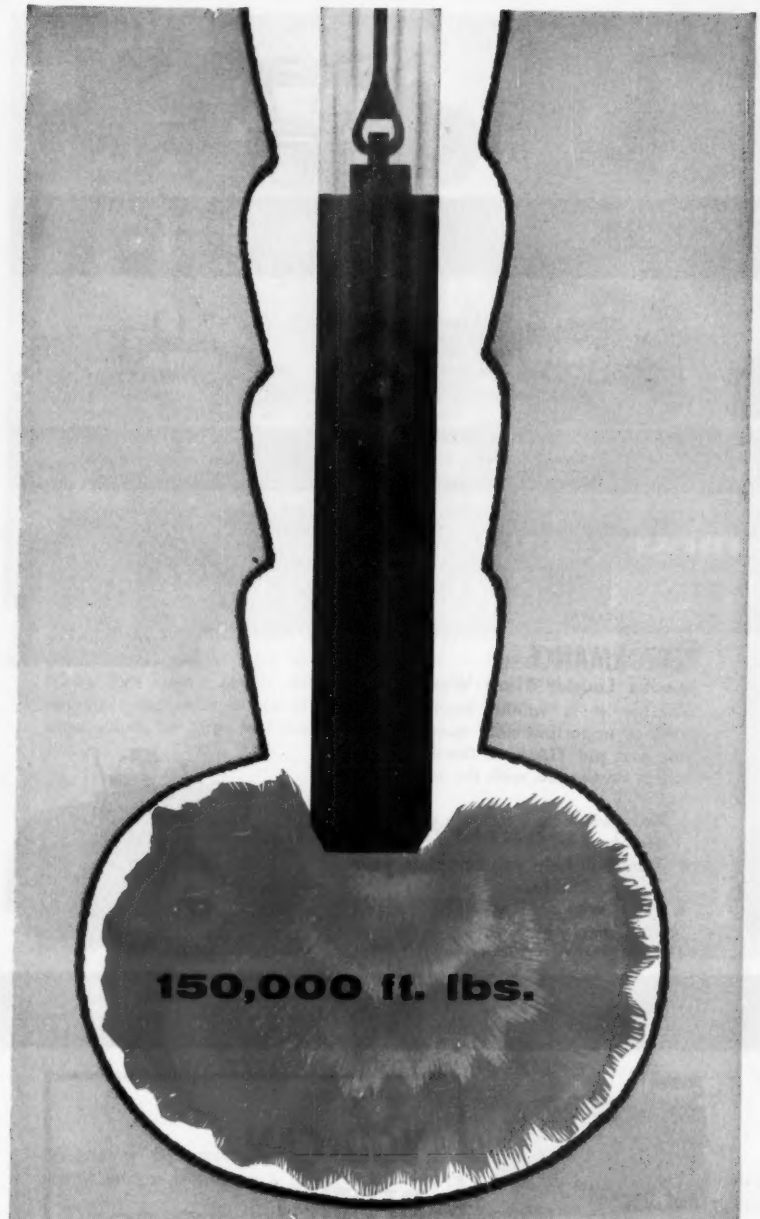
Fabricators:
Allison Steel Manufacturing Co.,
Phoenix, Arizona

High over Pinto Creek Canyon, railings of Reynolds Aluminum withstand weather without painting or maintenance . . . fit modern bridge design . . . and provide ample strength at low installed cost. This railing is the "vertical" type, assembled entirely from extruded sections (profiles shown). These extrusions are standard, produced on order from standard dies. Other types of bridge railings utilize Reynolds Aluminum Pipe, which is a standard mill product available through regular distributors. For sources of standard products and for advice on special aluminum requirements, call the nearest Reynolds office listed under "Aluminum" in classified directories. For booklet, "Aluminum Bridge Railings," write to **Reynolds Metals Company,** General Sales Office, Louisville 1, Kentucky.

For quick reference see Catalog 5a/Re in Sweet's Architectural file.

REYNOLDS ALUMINUM

See "FRONTIER," Reynolds great dramatic series, Sundays, NBC-TV Network.



NOT formed by 15,000 ft. lb. blows of indirect energy

BUT "forged" by 150,000 ft. lb. blows of direct impact!

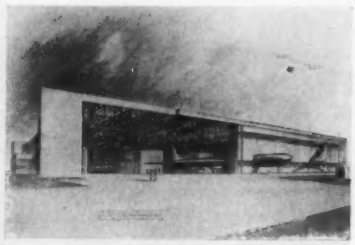
if **YOU** can...

Insist on the **BEST** in Foundations

Planning construction? Let us help plan your next meeting with a speaker and color slides.

FRANKI FOUNDATION COMPANY

103 PARK AVENUE, NEW YORK 17, N.Y.



FRANKI FACTS

In designing foundations for a double-cantilever maintenance hanger for Hanscom Air Force Base at Bedford, Mass., the U. S. Corps of Engineers originally planned spread footings. The F. D. Rich Company, prime contractors, proposed the use of Franki Displacement Caissons as an alternate design which was accepted by the Corp of Engineers and by the Kuljian Corporation of Philadelphia, Design Engineers.

A total of 126 Franki Displacement Caissons were used to support the main structural loads which were located in the central part of the hanger. Conventional spread footings were used under the walls, corners and door pockets. Standard caissons, of 22" shaft diameter and reinforced, were driven to an average depth of 35 feet by the Franki Method. Under a test load of 240 tons (twice the actual design working load) a single caisson showed a net settlement of less than $^{3}/_{16}$ of an inch.

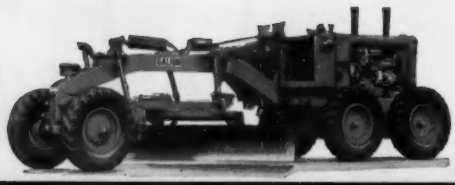
In addition to cutting installation time in half, the use of the Franki Method resulted in an additional saving of over 400 cubic yards of heavily reinforced concrete.

***RESULT:* A SAVINGS IN COST OF $40,000!**

LITERATURE AVAILABLE

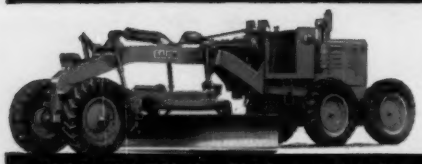
A brochure describing various Franki Foundation methods will be furnished upon request. Write to:

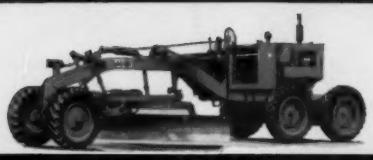
Franki Foundation Company
103 Park Avenue
New York 17, New York

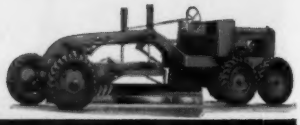


3 GRADERS *With* GRADE-O-MATIC *Torque Converter Drive*
Model T-700, 190 h.p. 40,125 lbs. Model T-600, 140 h.p. 30,785 lbs. Model T-500, 125 h.p. 25,000 lbs.

MODEL 118 GRADER
115 OR 125 h.p., 24,910 lbs.







MODEL 104 GRADER, 100 h.p., 23,635 lbs.
MODEL 450 GRADER, 75 h.p., 22,415 lbs.

MODEL 303 GRADER
55 h.p., 14,445 lbs.

MODEL 503 GRADER
50 h.p., 9,360 lbs.

ESTABLISHED GALION 1907

The most complete line of GRADERS and ROLLERS available

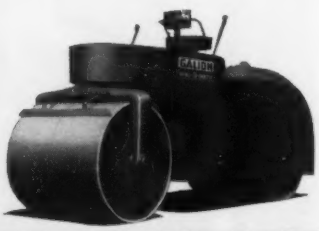
PERFORMANCE
Speaks Louder Than Words

Whether it is routine maintenance work or important new construction, you can put GALION Graders and Rollers on the job with the assurance that —

- **They will help you keep your jobs on schedule.**
- **They will help you complete your jobs profitably.**
- **They will give you the longest satisfactory service.**

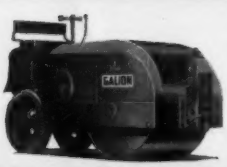
Write for literature

THREE-AXLE TANDEM ROLLERS
With ROLL-O-MATIC Torque Converter Drive. Variable Weight, 14-20 Ton.



TWO-AXLE TANDEM ROLLERS
With ROLL-O-MATIC or Gear Shift Drive. Variable Wt., 5-8, 8-10½, 8-12, or 10-14 Ton

THREE-WHEEL ROLLERS
Spoke-Type or Variable Weight Rolls
"Warrior", 2 Sizes — 7 to 10 Ton
"Chief" ROLL-O-MATIC, 4 Sizes - 10 to 16 Ton



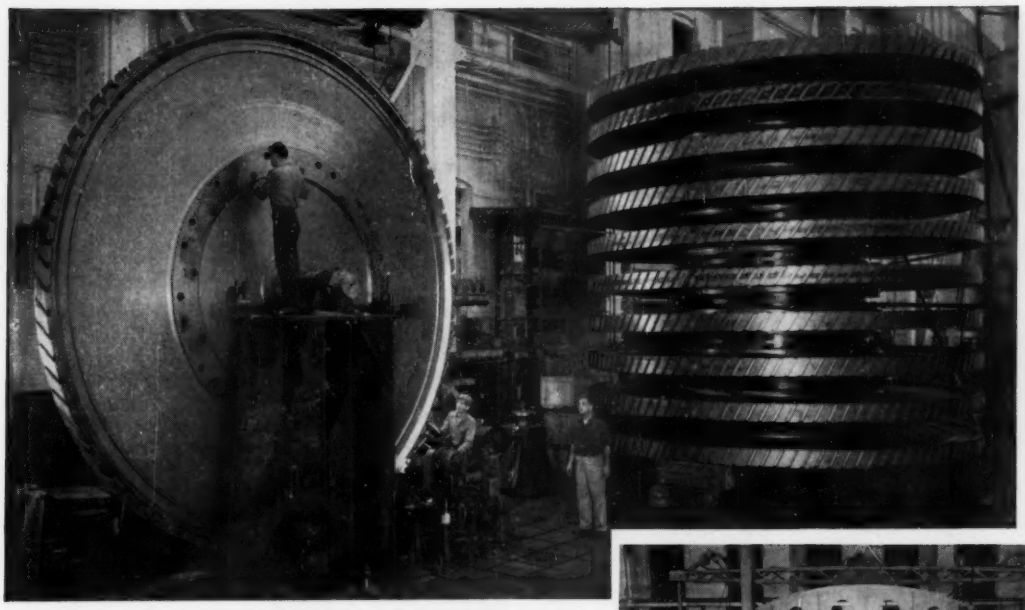
PORTABLE ROLLER
Variable Weight
7100-9765 lbs.

SMALL TANDEM ROLLERS
3-5 Ton Variable Weight
4-6 Ton with Retractable Wheels

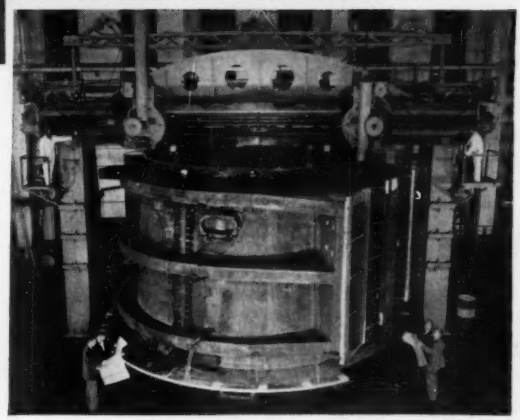
TRENCH ROLLER
Variable Weight
8785-10220 lbs.

YOU CAN DEPEND ON A... GALION FOR TOP PERFORMANCE

THE GALION IRON WORKS & MFG. CO.
General and Export Offices, Galion, Ohio, U.S.A.
Cable Address: GALIONIRON, Galion, Ohio



Rotor discs for mammoth 11-stage compressor were balanced and stacked for alignment in one of Newport News' five huge machine shops. Large engineering and technical staffs with a vast plant make Newport News an ideal source for large equipment . . . *standard or special in design.*



A 35-foot boring mill in Newport News' plant machining the 374,000-pound upstream housing for the giant axial flow compressor. The compressor is heart of an 8-foot supersonic wind tunnel at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, Calif.

To create winds exceeding

2000 MPH

Newport News builds world's Mightiest Compressor

Whenever you want large units built with careful attention to detail, give the job to Newport News.

This company recently built an eleven-stage axial flow compressor that shatters all previous records for wind force . . . using what is believed to be the world's largest rotating object.

The rotor, weighing more than 400 tons, comprises eleven huge discs. Each disc, machined from a 96,000-pound forging, was finished to a 50,000-pound wheel and balanced to within 26 ounces at the rim. In each rim, slots for blades were machined to within .005″ on special milling heads designed and produced in the Newport News plant.

Here at Newport News, you'll find more than large productive capacity. In machine shops, foundries and forging plants Newport News craftsmen complete your orders with specialized techniques backed by experience in fabricating thousands of products.

Newport News' craftsmen produce units that range from small components of spinning machines, to mammoth hydraulic turbines . . . from piping, pumps and valves, to vacuum tanks, digesters and bridge caissons.

These skilled men handle the job exactly as you want it done, for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and products" . . . it's yours for the asking.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia

GOING IN...

...a long-term investment

It's Transite Ring-Tite Pressure Pipe

• Transite® Ring-Tite® Pressure Pipe is a community investment that pays off year after year!

Its remarkably high flow characteristics protect that investment by keeping maintenance and pumping costs at a minimum during its long service life.

Corrosion Resistant

Transite Pipe is strong, durable, and highly resistant to corrosion. And it is immune to tuberculation, the form of interior corrosion that chokes the flow and increases pumping costs. Transite cannot tuberculate, thus its original high flow capacity is maintained, and pumping costs are kept at a minimum year after year.

The Ring-Tite Coupling, with rubber rings compressed and locked in place forms a joint that is tight yet flexible. Rings cannot blow out, and the automatic separation of the pipes within the coupling helps to relieve line stresses.

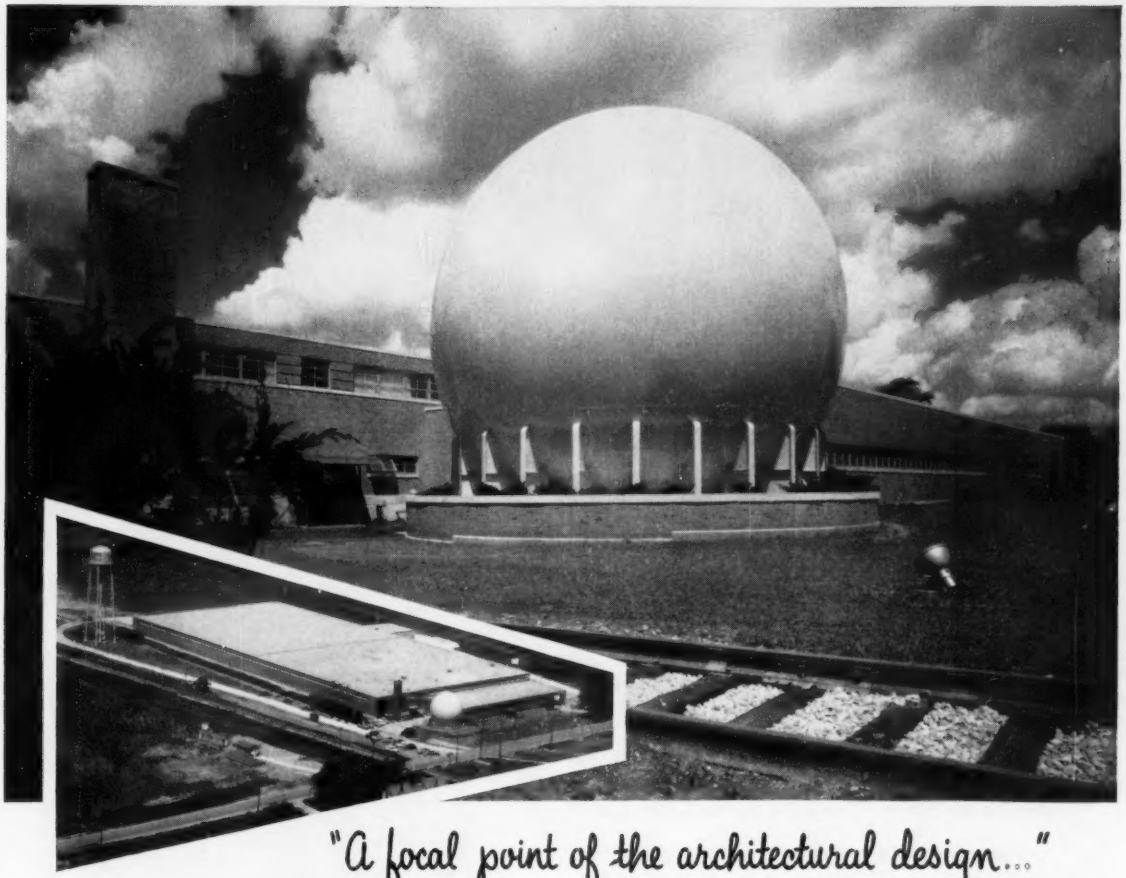
For further information about Transite Pressure Pipe and the Ring-Tite Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

WITH THE RING-TITE COUPLING

200,000-gal. Horton Spherical Water Storage Tank



"A focal point of the architectural design..."

at Waxdale

• A 200,000-gal. Horton® spherical water storage tank, used to supply the plant sprinkler system, was chosen for Waxdale, Johnson Wax, Inc. Shipping Center at Sturtevant, Wisc. According to J. P. Halama, Johnson's Staff Architect, "We decided to make the reservoir a focal point of the architectural design and therefore, chose a sphere because of its aesthetic value." In addition, a 100,000-gal. Horton elevated tank was also installed to provide dependable *gravity* pressure water supply.

CB&I has complete facilities to design, fabricate and erect steel plate structures of standard or unique design. Write our nearest office for further information.

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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

HARVEY, ILLINOIS ENDS PROBLEM OF FLOODED BASEMENTS WITH

CONCRETE PIPE

To end a vexing problem of flooded basements in a large section of the city, Harvey, Ill. built a new relief concrete pipe storm and sanitary sewer. Both the old and the new sewer lines connect with the system of the Chicago Sanitary District at the north city limits.

The project used more than 40,000 ft. of concrete pipe 21 to 90 in. in diameter. It was financed by two bond issues—$675,000 in revenue bonds and $1,500,000 in general obligation bonds.

Like Harvey, hundreds of American cities depend on long-lasting concrete pipe sewer installations. These many systems have demonstrated concrete pipe's rugged durability, great structural strength, maximum hydraulic capacity, minimum infiltration and leakage, and unusual resistance to abrasion.

Concrete pipe sewers are moderate in first cost, require little maintenance and give lifetime service. The result is true ***low-annual-cost*** sewer service. Write for free 48-page booklet, *"Concrete Sewers,"* distributed only in the United States and Canada.

PORTLAND CEMENT ASSOCIATION

Dept. 4-13, 33 W. Grand Ave., Chicago 10, Ill.

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

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• Since 1867 engineers, scientists, designers, surveyors, draftsmen have relied on K&E as the foremost, most progressive, and most complete source of supply for the tools, equipment, and materials they work with. When you buy, think first of K&E, headquarters for 7,000 items. For example . . .

THE PARAGON® DRAFTING MACHINE

Thorough knowledge and thorough care of minutest detail were essential to the designing of the sturdy, accurate Paragon® Drafting Machine. Draftsmen prefer the Paragon, because it is time-saving and work-sparing, because it is reliable, easy to operate, and because they don't have to treat it with kid gloves. The Paragon Drafting Machine increases drafting room efficiency enormously, and effects substantial economies.

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EST. 1867
New York • Hoboken, N. J.
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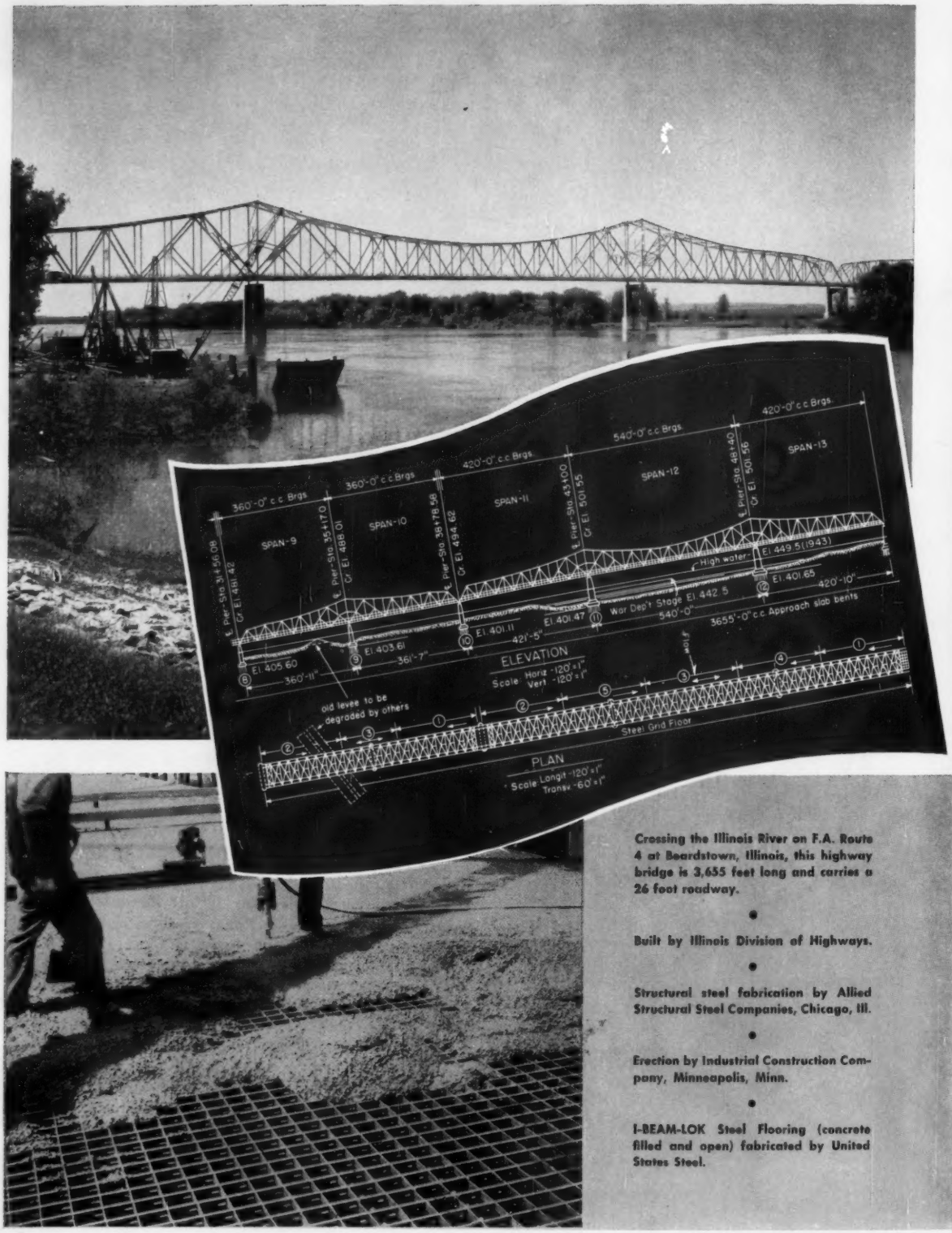
Up against a weight problem—they used



Crossing the Illinois River on F.A. Route 4 at Beardstown, Illinois, this highway bridge is 3,655 feet long and carries a 26 foot roadway.

•

Built by Illinois Division of Highways.

•

Structural steel fabrication by Allied Structural Steel Companies, Chicago, Ill.

•

Erection by Industrial Construction Company, Minneapolis, Minn.

•

I-BEAM-LOK Steel Flooring (concrete filled and open) fabricated by United States Steel.

USS I-BEAM-LOK

—reduced flooring deadweight over 50%

The original design of this highway bridge across the Illinois River at Beardstown, Ill., was based on the use of open-type steel flooring on the 2100′ continuous truss spans. However, after the design was completed —but before work had started, it was decided to change to a concrete filled floor.

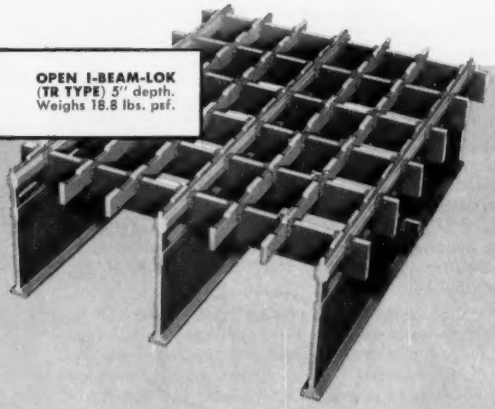
If this change had been made with conventional 7″ concrete slabs, the floor dead load on the truss superstructure would have been quadrupled. To accommodate the added weight, the entire superstructure, as well as the foundations, would have had to be completely redesigned.

Instead, the engineers solved the difficult problem by the simple and economical expedient of substituting lighter weight, yet stronger structural members (USS TRI-TEN A-242 Steel), *and by using USS concrete filled I-Beam-Lok for the 26′ roadway of the bridge.*

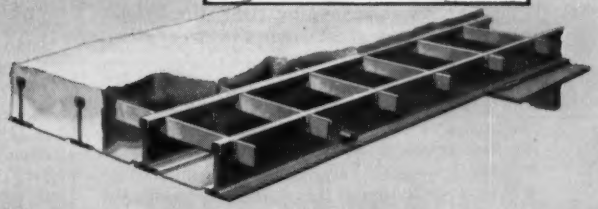
Revised plans called for 44,046 sq. ft. of 3″ concrete-filled I-Beam-Lok (weighing only 47 lbs. psf) and 9,788 sq. ft. of 5″ open-type I-Beam-Lok (weighing only 18.8 psf) for a 2′-4″ gutter on each side.

The result is an extra serviceable bridge roadway floor which weighs only 2,254,000 lbs. as against 4,700,000 lbs. if a conventional solid 7″ concrete floor had been used. Thus, by using USS I-Beam-Lok lightweight steel bridge flooring, the possible dead load of the floor on the Beardstown bridge was reduced *more than* 50%!

OPEN I-BEAM-LOK (TR TYPE) 5″ depth. Weighs 18.8 lbs. psf.



CONCRETE-FILLED I-BEAM-LOK available in 3″ (shown) and 4¼″ depths. Weighs 47 lbs. psf and 61 lbs. psf respectively including weight of concrete. If ¾″ over-fill is used, add 9 lbs. psf to each of the above weights.

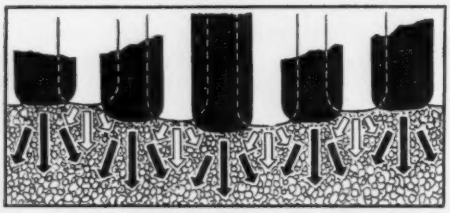


AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS I-BEAM-LOK

UNITED STATES STEEL

How oscillating wheels can save you untold street maintenance costs...



See the flow of compaction effort that the BROS Self-Propelled roller **with torque converter drive** provides for street seal coating, resurfacing and shallow lift compaction...

Here's how it is helping cities throughout the country make great savings in street maintenance costs:

- With full oscillation of all wheel pairs to provide uniform compaction, the BROS SP-54 helps "key" and "lock" aggregate materials tightly in the base course to prevent various pavement failures.
- Wheel oscillation of this roller also kneads the asphalt into a tight, solid surface, eliminating hairline cracks that would otherwise turn into surface breaks. Very important, too, rubber tire rolling correctly imbeds the wearing course chips *without* crushing them.
- Besides such proven advantages, the BROS SP-54 offers these time-saving performance features: a torque converter drive provides smooth, easy handling and eliminates "tipping" of chips when starting; it also lessens drive line strain.
- Full-reversing type transmission with shuttle gear permits rolling in either direction without shifting; turn arounds are thus eliminated.
- Infinite speed range from 0 to 18 mph; positive chain drive to both rear wheel pairs; 50 HP engine and smooth, hydraulic steering provide fast, proper compaction results that you can't get from any other roller. See a BROS Distributor or write us for full information and/or a demonstration. WM. BROS BOILER & MFG. CO., ROAD MACHINERY DIVISION; 1057 TENTH AVE. S. E., MINNEAPOLIS 14.

Find out, too, about the complete BROS TEAM. With the SP-54, the BROS Preparator and Roto-Mixer make the perfect combination for low cost street construction. The Preparator (in-place materials reducer) reduces native over-size materials and old blacktop to proper roadbed sizes. The Roto-Mixer stabilizes and blends the base and wearing course materials to improve load bearing values.

Self-Propelled Roller Roto-Mixer Preparator

BROS

Here's the Inside Story of Why You Get Lasting Accuracy, Eliminate Costly Repairs with . . .

Brunson's Patented

DUSTPROOF BALL BEARING CONSTRUCTION!

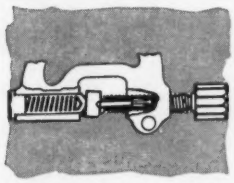
Engineer's Transit Model 50

Think surveying instruments are all pretty much alike? The "inside story" shows you why Brunson instruments are different—why they assure lasting accuracy and minimum maintenance unrivalled by any other instruments. The big difference is dustproof ball bearing construction!

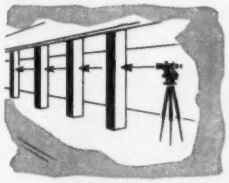
Located in the spindle and telescope axis, Brunson ball bearings are permanently lubricated by an all-temperature grease and sealed against dust and moisture. Preloaded and accurate to 5-millionths of an inch, these ball bearings provide highest possible instrument accuracy. With dust sealed out and lubricant sealed in, wear is practically eliminated by the smooth ball bearing action. That's why your Brunson instrument stays accurate and operable year-in-and-year-out, where others fail. You save hundreds of hours in on-work time, avoid costly errors, slash routine repair and maintenance expense to a level undreamed of in the past.

You pay no more for Brunson's exclusive ball bearing construction. Mail coupon today for the complete "inside story".

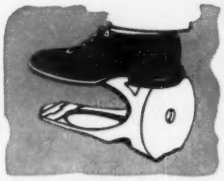
You Get These Big Advantages, Too!



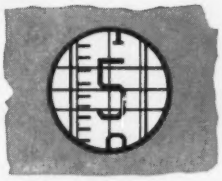
Wobble Pin in Tangent Screw Point—Enables your Brunson instrument to stay "on point" by eliminating strain and wear points that cause slippage.



Long and Short Shots in Collimation — Long and short shots are all in exactly the same straight line. No attachments needed for sharp focus at even 42 inches.



Sturdy, Heat Treated Cast Truss Standard—Supports over 200 pounds without bending or warping. Strong construction, throughout, withstands even the roughest handling.



Exceptionally Accurate Stadia Readings—Provided by coated lens with extra-sharp focus and strong, "no sag," Fiberglas cross wires. Wide field of view.

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City_____ County_____ State_____

NEWS OF ENGINEERS

Edward N. Noyes, distinguished Texas consulting engineer and former Vice-President of ASCE, was cited by the Texas Society of Professional Engineers as Corpus Christi's "Engineer of the Year" at the annual banquet observing National Engineers Week in February. Mr. Noyes has been in active practice since 1907—for 42 years as a partner in Myers and Noyes, consulting engineers of Dallas, Tex. For a number of years he was head of the firm's Corpus Christi office. Three years ago the firm was dissolved, and Mr. Noyes became chief consultant to Reagan and McCaughan, a new firm made up of former associates. Since 1940 he has been associated with virtually every Corpus Christi city and sewer project.

Edward N. Noyes

Irving B. Rau, consulting engineer of New Orleans, La., announces the relocation of his office to 302 Mason Building, 730 Gravier Street, New Orleans, La.

Delbert B. Freeman, Colonel, Army Corps of Engineers and Technical Liaison Division chief to the Chief of Engineers, has been asssigned to the Army Language School, Monterey, Calif., to take the Spanish course preliminary to an assignment in Latin America. As chief of the Technical Liaison Division, he served as staff officer directly responsible to the Chief Engineer for all public information activities of the Corps of Engineers. Colonel Freeman has a broad background of experience in engineering design and construction as both a civilian engineer and officer in the Corps of Engineers since 1928.

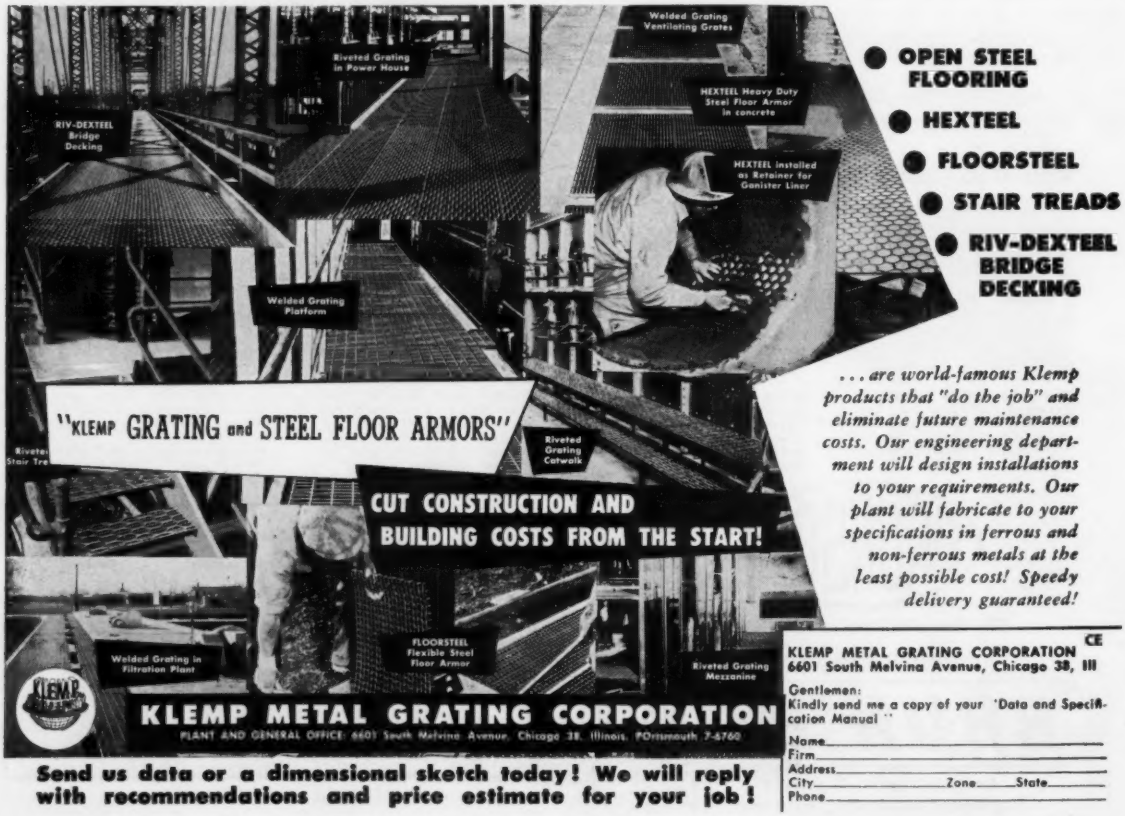
Francis M. Tompkins, senior vice-president of the Charles H. Tompkins Co., Washington, D.C., was elected president of The Master Builders' Association Inc., at the recent annual meeting of the organization at the Mayflower Hotel in Washington.

Jack D. White, structural designer in the Bridge Section of the Colorado Department of Highways and a resident of Denver, has been elected secretary-treasurer of the Metropolitan Chapter of the Professional Engineers of Colorado.

Roger W. Mueller, civil engineer, Wisconsin State Highway Commission, Madison, Wis., has become civil engineer of Oconto, Wis. Mr. Mueller worked for the State Highway Commission in the Rhinelander, La Crosse, and Madison districts and was construction engineer on a section of the Pennsylvania Turnpike. His residence is 423½ Congress St., Oconto.

Eugene H. Harlow, executive vice-president of Frederic R. Harris, Inc., Consulting Engineers of New York, will be in charge of a branch office being opened at 1915 Tulane Avenue, New Orleans. The firm is being retained by the Offshore Company to act as its engineering representative in the area.

John A. Logan, professor of civil engineering at the Northwestern Technological Institute, Evanston, Ill., has been appointed to the Vector Control Committee of the National Research Council. An authority on health and sanitation, Dr. Logan was on the staff of the Rockefeller Foundation in Europe for eight years before joining the faculty of Northwestern University in September 1954.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Alfred J. S. Pippard, noted British engineer, and head of the department of civil engineering at Imperial College, University of London, will join the Northwestern Technological Institute faculty for 1956–1957 as a visiting professor of civil engineering. An authority on aircraft structures, stress analysis, and elasticity, Dr. Pippard will serve both in teaching and advisory capacities while at Northwestern.

Kenneth Brunner has established an office for the practice of civil engineering at 2918 Gilroy St., Los Angeles, Calif. Mr. Brunner was formerly chief design engineer for Francis H. Bulot, Consulting Engineers, Inc., of Pasadena, and prior to that was in charge of design and construction for the civil engineering work on the Disneyland Project in Anaheim, Calif.

William P. Price, Jr., for the past two years assistant chief engineer of the United Water Conservation District, Santa Paula, Calif., has been appointed general manager and chief engineer. He succeeds **Julian Hinds,** under whose administration the water storage plan was developed for the District and the first unit constructed—the 100,000-acre ft reservoir behind Santa Felicia Dam. Mr. Hinds has opened a consulting office in Santa Paula and been retained as a consultant by the District.

Francis S. Friel (center), president of Albright & Friel, Inc., and former Director of ASCE, is cited by the Pennsylvania Society of Professional Engineers as metropolitan Philadelphia's "outstanding engineer." Presentation of the award is made by Allan H. Kidder (left), director of the N.S.P.E., at a luncheon at the Philadelphia Engineers' Club, highlighting the celebration of National Engineers' Week. Dr. James Creese, president of Drexel Institute of Technology, of which Mr. Friel is an alumnus, is at the right.

(*Continued on page 28*)

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

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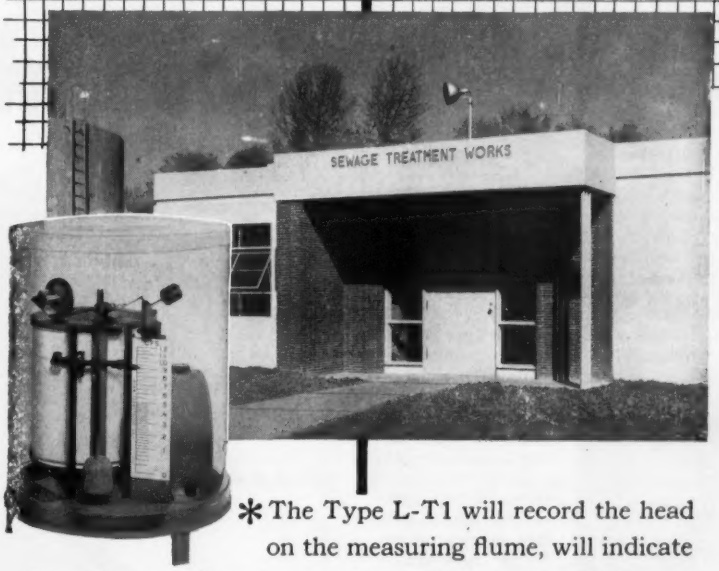

* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

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144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

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News of Engineers

(*Continued from page 27*)

John F. McCarthy has been appointed director of the new department of civil engineering at St. Louis University's Institute of Technology, recently set up as a separate department. Previously Mr. McCarthy was chief structural engineer for W. R. Bendy Consulting Engineers and for the Fruin-Colnon Contracting Company. He is a graduate of Missouri School of Mines and was a member of the faculty there.

Patrick J. Cusick, Jr., assistant director of the Pittsburgh Regional Planning Association, Pittsburgh, Pa., has been named an assistant director of the Allegheny Conference on Community Development. He will be in charge of the Conference's engineering and technical studies and will continue his work with the Regional Planning Association.

Daniel Beaton has become a partner in the firm of William A. Rose Associates, consulting engineers of New York. Mr. Beaton was formerly chief structural engineer for Lorimer & Rose, architects and engineers, on several school, public, and long distance switching-center projects in the metropolitan area.

William J. Hedley, assistant chief engineer, Wabash Railroad Company, St. Louis, Mo., was elected president of the American Railway Engineering Association on March 14 during the organization's annual convention held at the Palmer House in Chicago. Mr. Hedley, who held the office of vice-president of the association in 1955, was installed with other new officers on March 15 at the end of the convention.

W. J. Hedley

Albert Larsen, Jr., of Staten Island, N.Y., was appointed deck officer in the U. S. Coast and Geodetic Survey, on February 9. He will be assigned to Ship Explorer, with headquarters at Seattle, Wash., and will be engaged in hydrographic surveys in Alaskan waters during the coming summer season. Mr. Larsen is leaving the employ of Parsons, Brinckerhoff, Hall & Macdonald, New York City consulting engineers.

Paul Rogers & Associates, consulting structural engineers of Chicago, have moved to 20 East Jackson Blvd., Suite 703, Chicago 4.

Samuel C. Blast, supervising structural engineer with the firm of Seelye, Stevenson, Value & Knecht, consulting engineers of New York City, was recently made an associate in the firm.

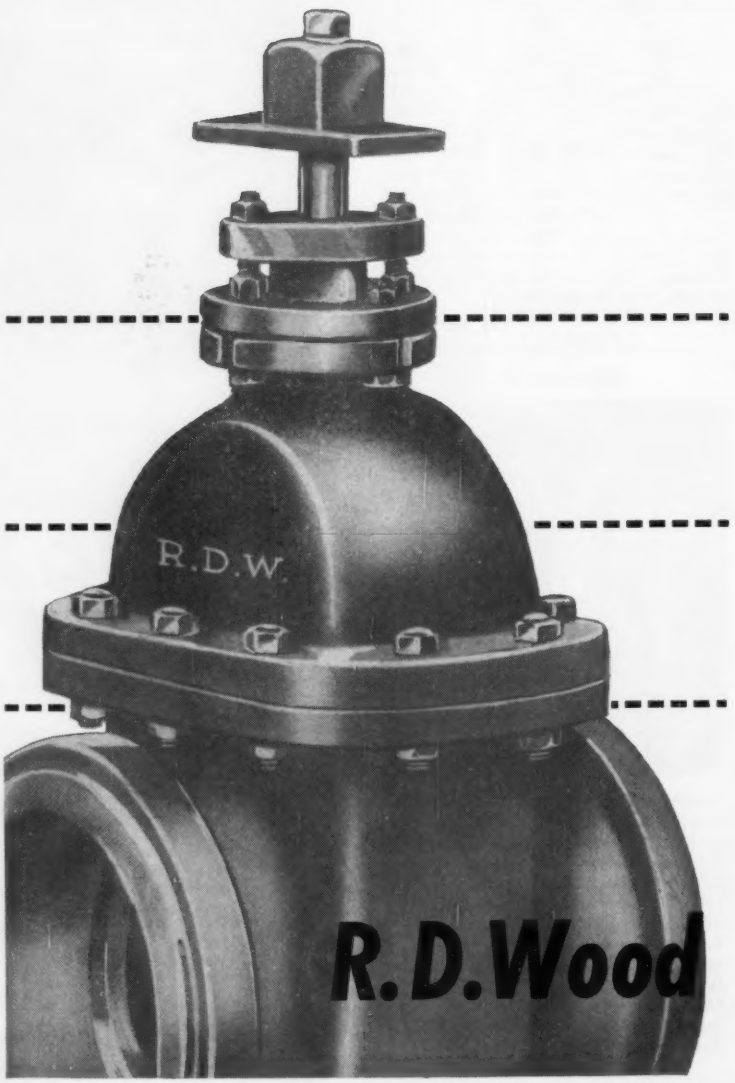
George T. Derby, Colonel, Corps of Engineers, U. S. Army, and district engineer at Huntington, W. Va., is retiring from the Army on May 1 after nearly 29 years of service. He will join the executive staff of the Ashland Oil & Refining Company at Ashland, Ky. During the past three years Colonel Derby has been engaged on Ohio River improvement and flood control work throughout his district. In 1951 he was in charge of the construction of Air Force Bases in North Africa.

George T. Derby

Carroll B. Porter, assistant chief engineer of the Southern Region of the Chesapeake & Ohio Railway, Richmond, Va., was recently appointed assistant to the vice-president of construction and maintenance, with headquarters at Huntington, W.Va. Mr. Porter has been with the C. & O. since 1922, holding various positions in the engineering department in Huntington and Richmond.

W. D. Broyles, consulting engineer of Baytown, Tex., announces the formation of a partnership with **Albert S. Bynum,** for the past fifteen years a project engineer with the Humble Oil & Refining Company. The new firm name is Broyles and Bynum, Consulting Engineers.

Nobody wants to dig



Henry M. Wasung has opened a consulting office at 65 Woodcrest Circle, Springfield, N.J. Mr. Wasung was an engineer with Spencer, White & Prentis, Inc., on the "lifeline to Russia" project in Persia and Arabia during the war and was an engineer for the Alabama Dry Dock & Shipbuilding Corp. More recently he has been chief estimator for the Drilled-In Caisson Corp., New York.

Henry M. Wasung

William E. Potter, Brigadier General, Army Corps of Engineers, has been nominated by President Eisenhower to be Governor of the Panama Canal Zone, subject to Senate confirmation. General Potter is division engineer of the Missouri River Division of the Mississippi River Commission at Omaha, Nebr. He will succeed **Maj. Gen. John S. Seybold,** who is retiring from the Army.

Maurice M. Class, consulting engineer and retired Colonel, Army Corps of Engineers, has been appointed by Lord Ismay, the Secretary General of NATO, to serve as Airfield Engineer on the NATO International Staff. Colonel Class served in both the European and the Pacific Theaters, during World War II and later in Korea. He has been engaged in the design and construction of Military and civilian airfields.

Mason G. Lockwood, William M. Andrews and **Frank H. Newnam, Jr.,** partners in the consulting engineering firm of Lockwood & Andrews, announce the firm's name has been changed to Lockwood, Andrews & Newnam. The firm has offices in Corpus Christi, Houston, and Victoria, Tex.

Bernard L. Weiner has resigned his position with the firm of Tippetts-Abbett-McCarthy-Stratton, of New York City, to become chief engineer of the Leonard S. Wegman Co., Engineers, of New York City.

Robert C. Boesser has joined the construction engineering staff of the Knolls Atomic Power Laboratory which General Electric operates for the Atomic Energy Commission. The laboratory is currently working on the Submarine Advanced Reactor Project, a nuclear power plant for a high-performance submarine. Mr. Boesser recently resigned as project engineer for the Merritt-Chapman & Scott Corp. after completion of the company's participation in the Portsmouth AEC construction program, and has now moved to Schenectady, N.Y., to take up his new duties.

Glynn Davies Barranger, civil engineer of Roanoke, Va., has been named an associate in the architectural-engineering firm of Hayes, Seay, Mattern and Mattern of Roanoke. Mr. Barranger has been town manager of Marion, Va., for the past three years, and before that was employed as a field engineer by L. S. Bradshaw & Sons contractors.

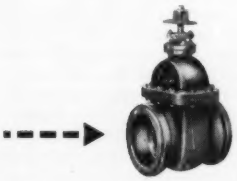
Paul O. Harding, for the past six years assistant state highway engineer in charge of state highway development and operation in Los Angeles, Orange, and Ventura counties, is retiring after 27 years of service with the California Division of Highways.

Paul Harding

Of recent years he has been identified with construction of the metropolitan freeway network in the Los Angeles area. Mr. Harding is taking up residence in Tegucigalpa, Honduras, where he will be resident chief engineer for O. J. Porter on a program of highway building and improvement for that country. Succeeding him as assistant state highway engineer is **Edward T. Telford,** former district engineer in charge of planning. Mr. Telford's former duties are being assumed by District Engineer **George Langsner,** who has been in charge of operations for District VII.

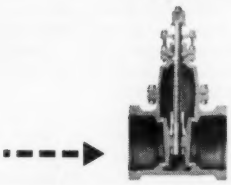
up gate valves

Reliability is the important consideration in gate valves. They have got to work and *keep on working* even after years of idleness in the lines. Digging them up for repairs is too costly—as well as a possible fire or health hazard while they are out of operation.



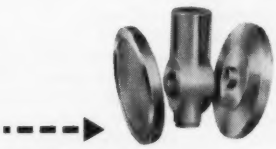
Nobody Need Dig Up This Gate Valve

The R. D. Wood Gate Valve is designed for severe underground service. It can be counted on to do what is expected of it for scores of years.



Simple in Design

The Wood Gate Valve is reliable, because there's nothing to go wrong. It is rugged, fully bronze mounted, suitable for working pressures up to 175 pounds.



Only Three Moving Parts

Just a spreader and two discs—no small wedges or delicate parts.

Revolving Discs

One of the secrets of Wood gate valve reliability is that the discs are hung loosely. They are free to revolve their complete circumference while being raised or lowered. There's no dragging of the faces to cause wear at one point.

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The fully opened valve provides unobstructed passage. Gates are lifted entirely clear of the valve openings.

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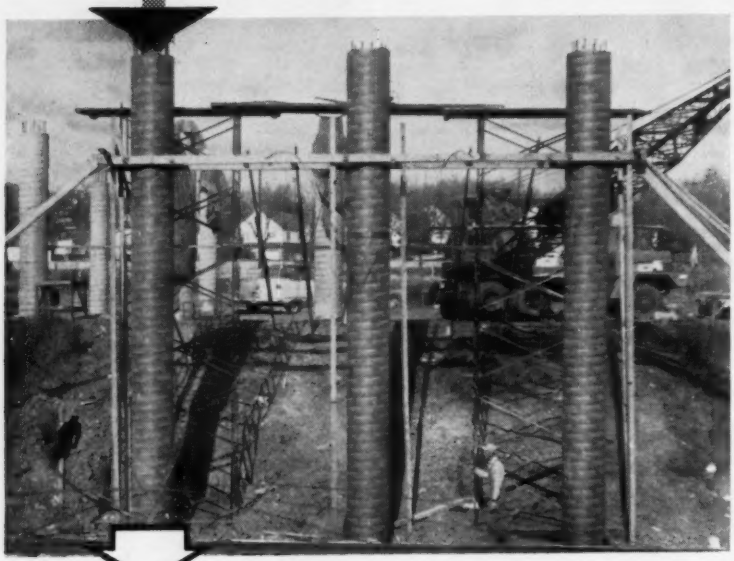

Highway Overpass, near Kansas City, Kan. State Highway Commission of Kansas, Bridge Dept., designers. L. G. Barnes & Sons, contractors

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New in Education

Research Projects. Armour Research Foundation of Illinois Institute of Technology will mark its 20th year of service through research in 1956. The role of industrial research in the nation's economy will be spotlighted. . . . No longer is there any doubt that steel H-beam pilings can be used safely as foundations for modern skyscrapers. An investigation of the suitability of bearing piles for foundation construction in the Chicago Loop reveals that the steel pilings far exceeded required strength. The study was conducted by Armour Research Foundation of Illinois Institute of Technology, Chicago, for the U. S. Steel Corp. . . . A hangar-sized test chamber on the Cornell campus is giving university engineers a chance to find out how structures and materials react to the stresses and strains of actual use. The unusual facility is designed to act as a huge testing machine, capable of submitting a structure to three-dimensional tests. . . . Industry-sponsored research at the New York University College of Engineering increased 35 percent during the past year. . . . A broad study of Ohio highway accidents, aimed at determining the basic causes of traffic mishaps, is under way in the Ohio State University Engineering Experiment Station. . . . Two Stanford University graduate students, Peter Price and Robert W. Thompson, have developed a method for eliminating the hazard of tall smokestacks collapsing in a high wind. The remedy offered is to place a perforated sheet metal shroud around the smokestack from top to bottom, thereby stopping the wind-generated vibrations.

Scholarships and Grants. Purdue University's School of Civil Engineering and Graduate School are offering approximately 22 graduate fellowships for the summer session, June 11 to August 4, made possible by a free grant from the Asphalt Institute. Application forms and information from Prof. K. B. Woods, Head of the School of Engineering, Purdue University, Lafayette, Indiana. . . . Rutgers University is doing research on frost penetration in soils with a $22,700 grant from the National Science Foundation.

New Buildings. City College of New York recently paid honor to Gen. George W. Goethals, M. ASCE and chief engineer of the Panama Canal, by renaming one of its buildings "Goethals Hall", in his memory. . . . A new college of liberal arts, emphasizing basic science and engineering and bearing the name of the late Harvey Seeley Mudd, Hon. M. ASCE, Los Angeles mining engineer and civic leader, will be established at Claremont,

Calif., to meet the acute need for scientists and engineers in American industry. . . . The Georgia Institute of Technology recently dedicated its new $1,000,000 Rich Electronic Computer Center, said to be the first electronic computation laboratory at a southern institution of higher learning. . . . A gift of $450,000 has been made to the Speed Scientific School at the University of Louisville to go towards construction of a new building for civil and electrical engineering. The donors are Mr. and Mrs. William S. Speed, noted for their benefactions to the school. . . . The University of Wisconsin will build an $800,000 addition to Sterling Hall on the Madison campus to house the Mathematics Research Center of the U. S. Army.

New Courses. The Atomic Energy Commission and the National Science Foundation are jointly sponsoring, with the American Society of Engineering Education, a special Summer Institute on Nuclear Engineering for engineering college faculty members at Argonne Laboratory School of Nuclear Science and Engineering, beginning in June 1956. Information from the Dean of Engineering, Northwestern University, Evanston, Ill. . . . Miami University's Graduate School, in conjunction with the Department of Architecture, is offering a one-year graduate program leading to the degree, master in city design. Applications should be made to the Dean of the Graduate School at Oxford, Ohio, by June 1. . . . The University of North Carolina, School of Public Health, is offering graduate assistantships in sanitary engineering and sanitary science. Applicants must have completed an approved undergraduate program in civil mechanical, chemical or sanitary engineering. Further information from the Department of Sanitary Engineering, University of North Carolina, Chapel Hill, N. C. . . . Carnegie Institute of Technology offers opportunities for advanced study and research leading to the degree of master of science and doctor of philosophy in civil engineering. Teaching assistantships, research assistantships, and fellowships are available for the academic year 1956–1957. Information from the Dean of Graduate Studies, Carnegie Institute of Technology, Pittsburgh 13, Pa. . . . A department of civil engineering has been set up at Saint Louis University's Institute of Technology, with John F. McCarthy as director. . . . Massachusetts Institute of Technology has established a School for Advanced Study. It will provide means by which post-doctoral scholars from all over the world can join with the M.I.T. faculty in high-level theoretical studies and research. M.I.T. also offers broad opportunities for graduate study during 1956–1957. Fellowships and assistantships for either teaching or research will be available. Further information From Dean H. L. Hazen, Room 3-108, Massachusetts Institute of Technology, Cambridge 39, Mass.

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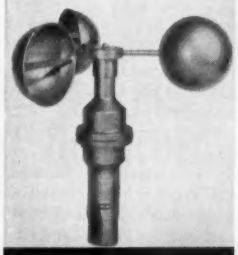

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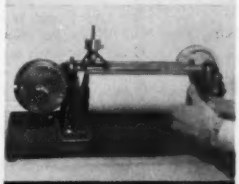

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Gurley Anemometers are in wide use at municipal and industrial pollution control laboratories, airports, weather stations, oil refineries, in homes and at shore installations. Other Gurley Wind Instruments for pollution control stations include: Wind Direction Instruments, Wind Velocity and Direction Recorders and Pilot Balloon Theodolites. *Write for Bulletin 6000.*

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Gurley Water Level Recorders make continuous graphic records for an entire day or week. Float-operated, simple in construction and operation, they are widely used in reservoirs, sewers, sewage disposal and hydro-electric plants, and supplement irrigation and stream gaging measurements. For details on these and many other Gurley Hydraulic Engineering Instruments, write for *Bulletin 700.*

Other Gurley Instruments to aid you in pollution studies include: Densometers for measuring porosity, air-permeability and air resistance of samples; Permeometers for measuring air flow through samples. *Write for further information.*

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Non-ASCE Meetings

American Institute of Architects. Eighty-eighth annual convention, Biltmore Hotel, Los Angeles, Calif., May 15–18. Information from AIA, 1735 New York Avenue, N.W., Washington 6, D. C.

American Society of Mechanical Engineers. Design Engineering Conference, Convention Hall, Philadelphia, Pa., May 14–17. Information from ASME, 29 W. 39th Street, New York 29, N. Y.

American Society for Testing Materials. Fifty-ninth annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 17–22. Information from ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Water Works Association. Diamond Jubilee Conference, St. Louis, Mo., May 6–11. All reservations should be cleared through the AWWA office, 521 Fifth Avenue, New York 17, N. Y.

American Welding Society. Annual Spring Meeting and fourth Welding Show, Memorial Auditorium, Buffalo, N. Y., May 9–11. Information from AWS, 33 W. 39th Street, New York 18, N. Y.

Chamber of Commerce of the United States. Forty-fourth annual meeting in Washington, D. C., May 14–15. Information from the Military Engineer, 808 Mills Building, Washington 6, D. C.

Colorado School of Mines. Symposium on Rock Mechanics, Golden, Colo., April 23–25. Information from L. J. Parkinson, Head, Mining Dept., Colorado School of Mines, Golden, Colo.

International Electro-Technical Commission. International conference on large electric systems, 16th International Conference, Paris, France, May 30–June 9. Further information from Philip Sporn, 30 Church Street, New York City, N. Y.

Management Engineering Conference. Eleventh annual meeting of Society for Advancement of Management and Management Division of American Society of Mechanical Engineers at Hotel Statler, New York, April 26–27. Information from Public Relations Department, SAM, 74 Fifth Avenue, New York 11, N. Y.

National Society of Professional Engineers. Annual meeting at the Ambassador Hotel, Atlantic City, N. J., May 23–26. Information from NSPE, 2029 K. Street, N. W., Washington 6, D. C.

Prestressed Concrete Institute. Second annual convention, Hollywood Beach Hotel, Hollywood, Fla., May 16–18. Further information from Prestressed Concrete Institute, P. O. Box 495, Lakeland, Fla.

Purdue University. Eleventh Industrial Waste Conference at Purdue Memorial Union, Lafayette, Ind., May 15–17. Information from Don E. Bloodgood, Professor of Sanitary Engineering, Purdue University, Lafayette, Ind.

Society for Experimental Stress Analysis. Spring Meeting at William Penn Hotel, Pittsburgh, Pa., May 16–18. Information from W. M. Murray, Secretary-Treasurer, Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 38, Mass.

Verein Deutscher Ingenieure. Centennial Celebration in Berlin, Germany, May 12–15. Information from Verein Deutscher Ingenieure, Prinz-Georg-Strasse 77/79, Dusseldorf, Germany.

Wire Reinforcement Institute. Annual Spring Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., May 28–30. Information from Don Gehring, Wire Reinforcement Institute Inc., National Press Building, Washington 4, D. C.

World Power Conference. Fifth World Power Conference, Vienna, Austria, June 17–23. Further information from U. S. National Committee, Stewart E. Reimel, Secy., c/o Engineers Joint Council, 29 W. 39th Street, New York 18, N. Y.

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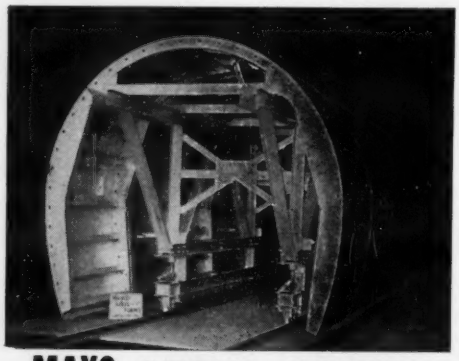

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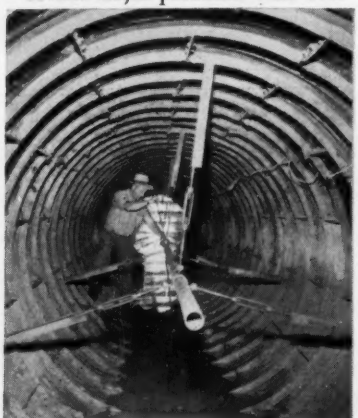
LOOKING DOWN vertical shaft to tunnel driven 33 feet under six-lane highway. Unaffected by weather conditions, men work around the clock in tunnel headings. Steel plates line shaft and tunnels, protecting men against cave-in.

MINING IN TUNNEL progresses close to pay line. When 4 square feet of ground is exposed, man bolts next plate into ring.

How COMMERCIAL tunnel liner plates are a time and money saving answer in soft ground tunnel construction. . .

RAPID PROGRESS is being made in driving 8400 feet of tunnel at depths as low as 33 feet below the surface by Mountain State Construction Company for the Sanitary Board of the City of Charleston, W. Va. Tunnels 84" and 68¾" in diameter, when completed later this year, will become part of the project that will intercept and pick up existing sewage lines now dumping into the Kanawha and Elk Rivers and divert the flow of all raw sewage to a new disposal plant now under construction.

Several major problems were overcome when consulting engineers decided, and the contractor agreed, that the steel tunnel liner plate system was the ideal method to use in driving these tunnels. I.V. Cunningham, Owner of Mountain State, says that he is using 2,000,000 pounds of COMMERCIAL steel liner plates because simplicity of the COMMERCIAL system makes rapid progress possible even though tunnels are being driven close to the river in wet ground where cave-ins are a constant hazard and beneath Kanawha Boulevard where traffic continues uninterrupted on one of Charleston's busiest arteries.



CHECKING ALIGNMENT, Vernon Cunningham says, "Once the first few feet of tunnel liner plates are in place, the remaining rings are practically self-aligning." LA-14

Setting the proper ground support quickly as mining progresses in the heading of a soft ground tunnel is of utmost importance. COMMERCIAL liner plates are curved to the exact required radius and because of their size, weight and design, one man can easily and quickly set them into place. Bolts are slipped through matching holes punched in the four inside flanges of the plates and nuts tighten up quickly with the use of only a spud wrench. There is nothing awkward in bolting the COMMERCIAL plate into place because everything is out in the open and you see just what you are doing.

Starting this contract with unskilled workmen, Mountain State has found that it worked out perfectly to let their men learn the COMMERCIAL liner plate system on the job, and in short order the crews performed as teams. With actual physical labor reduced to a minimum and the fear of cave-in hazards negated, Vernon Cunningham says, "They are happier workers than any I have seen in all my years in the construction business. This, of course, pays off in results. For my own part, I have found the COMMERCIAL liners a time and money saving answer to a difficult construction problem."

REMOVING MUCK from heading places additional load of 1500 pounds on monorail system suspended from steel liner plate lining.

Can we be of assistance to you on your next tunnel job? There's no obligation.

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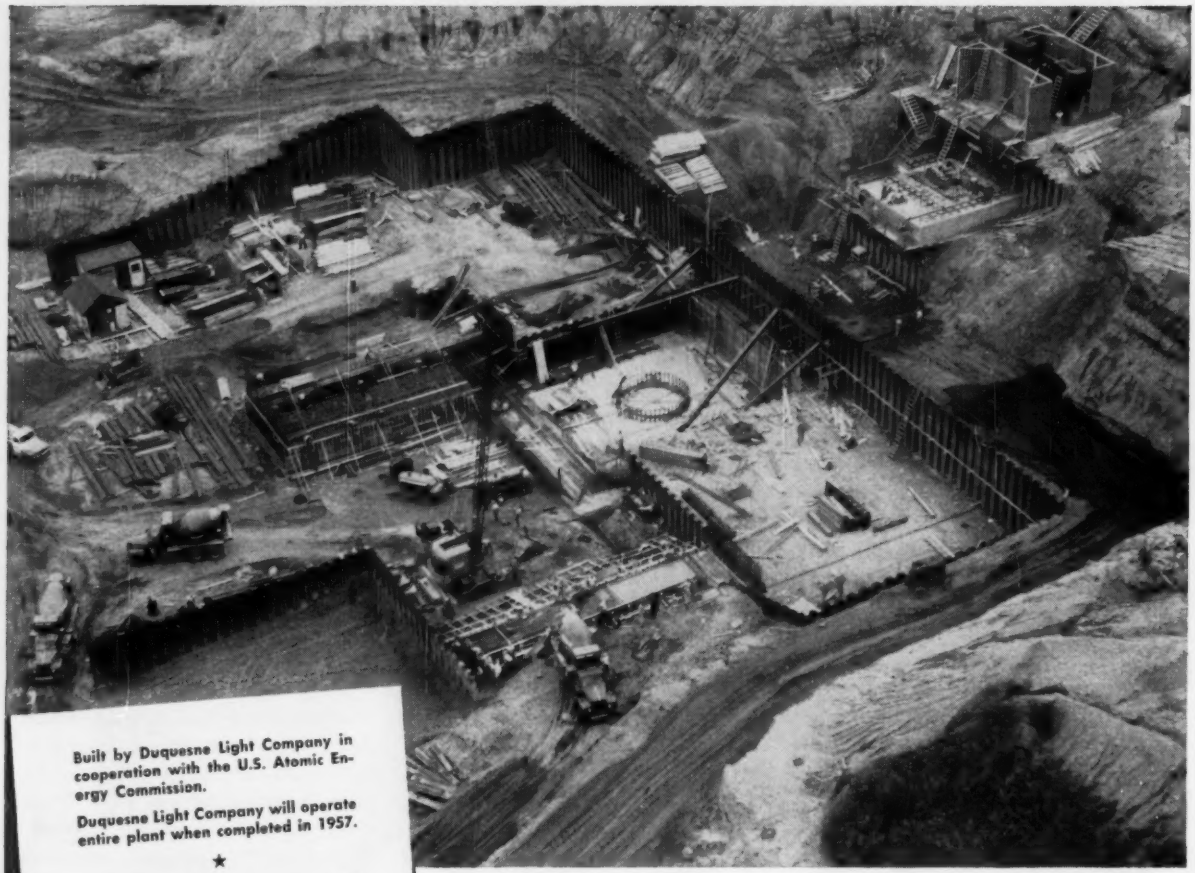


Built by Duquesne Light Company in cooperation with the U.S. Atomic Energy Commission.

Duquesne Light Company will operate entire plant when completed in 1957.

★

Westinghouse Electric Corp., under contract with the Atomic Energy Commission, is building the reactor.

★

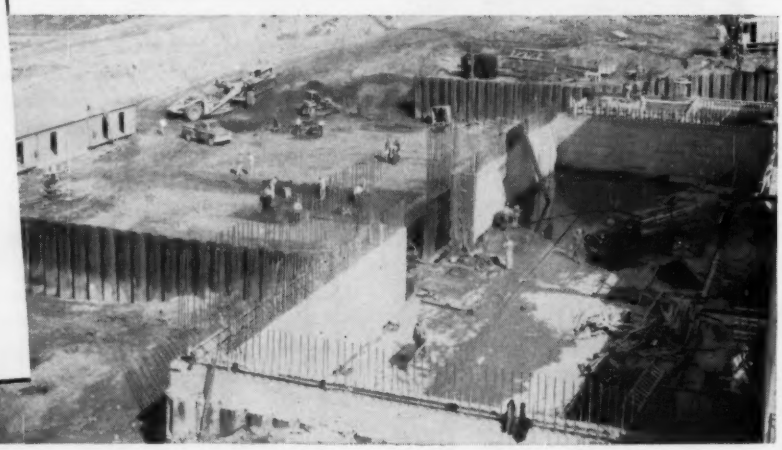
Burns and Roe, Inc. is the agent-constructor for Duquesne Light Co. Associates are J. Rich Steers, Inc., and Hatzel and Buehler, Inc.

★

Ferguson & Edmundson Company is sub-contractor for Excavation and Piling.

★

Stone and Webster Engineering Corporation is Architect-Engineer for Westinghouse.



Electric Power Plant—

SHEET PILING

wall for main structure of big project!

THE LARGE PICTURE at the left shows the foundation construction for the nation's first full-scale nuclear power plant.

Being built by Duquesne Light Company in co-operation with the Atomic Energy Commission, the huge project is located at Shippingport, Pa.—on the Ohio River about 25 miles below Pittsburgh.

This revolutionary plant, which will have a nuclear reactor producing at least 60,000-kw net electrical output, as well as a turbine-generator capable of 100,000-kw, will deliver electricity to Duquesne's customers in Allegheny and Beaver Counties.

Because the main structure will extend 75 ft. below grade, 23,896 lineal feet of USS sheet piling were driven to an average depth of 36 feet into the ground for the necessary retaining wall prior to the extensive excavating.

The approximately 700 tons of sheet piling not only served as the outside form for the pouring of the reinforced concrete walls, but were left in the ground permanently as a strong, durable steel skin for the concrete—*a double wall, so to speak.*

The application of USS Steel Sheet Piling at Shippingport is further proof that this versatile construction medium is the ideal solution to any problem involving the retention and control of earth or water. Forming a continuous wall, interlocking USS Sheet Piling offers easily installed construction that is strong, rugged and lasting.

For detailed information about this economical steel piling which is available in straight-web, arch-web, and Z-sections, contact the nearest office, or write to our Pittsburgh headquarters.

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BITUMULS SLURRY SEAL is a fast, simple, and highly effective technique for getting extra years of satisfactory service out of cracked, worn, or spalled pavements.

The slurry, itself, consists of a mixture of Bitumuls emulsified asphalt and water to which sand or crusher dust (or a combination of both) is added to form a free flowing mix.

Typical Slurry Preparation

On a typical successful operation, the Bitumuls emulsion and water were first fed into the drum of a transit mix truck. Then aggregate, conforming to the following gradation, was added slowly to assure complete coating:

Sieve Sizes	*Per cent Passing*
Number 20	100
" 30	91
" 50	54
" 100	20
" 200	5

Method Of Application

The slurry, delivered to the job in the transit mixer, was chuted into a spreader box, towed behind the mixer truck, onto the pre-watered pavement. (The spreader box was a rectangular, sled-like frame, one traffic lane in width. It was equipped with a rubber strike off, or squeegee blade, which assured even distribution and uniform coating, and forced the slurry into cracks and depressions.)

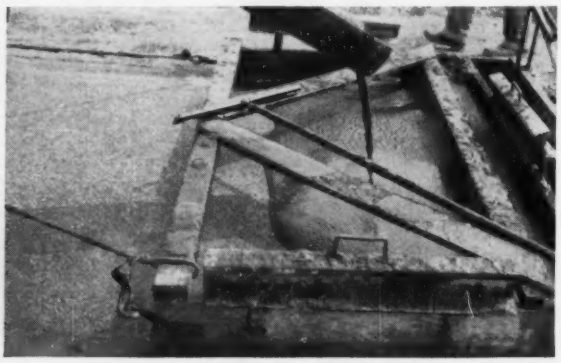
Pioneered In The West

Quickly and easily applied at exceptionally low costs, Bitumuls slurry sets rapidly and can usually be opened to traffic within two to three hours.

This method was pioneered by Los Angeles County forces. Working closely with them were Engineers of American Bitumuls & Asphalt Company.

Bitumuls Slurry Seal has been used effectively in both Southern and Northern California, and test sections have been placed in other areas of the country. The "big news" of this relatively new method of extending pavement surface life is spreading fast. Get full data from our nearest office.

Aggregate and Bitumuls are fed into transit mix truck, then water is added as required.



Close-up view of the specially-designed spreader-box.

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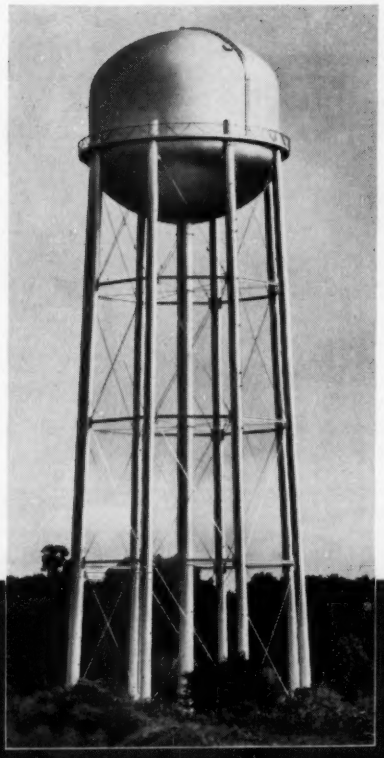

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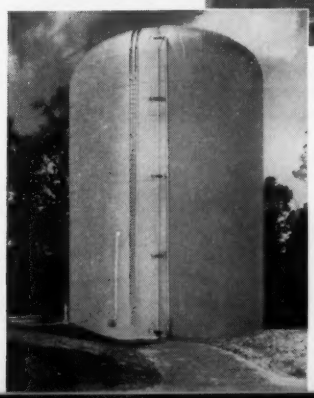

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do you know that

This is a special issue? Current techniques in coping with the Nation's No. 1 problem—the treatment of water, sewage, and wastes—are the subject of this multi-page issue.

Our total water consumption is staggering? Department of Commerce estimates place today's daily water use at 262 billion gallons. However, this is only a drop in the bucket to the 453 billion gallons forecast for our daily requirement in 1975. The startling water demands of the economy of the United States are discussed by the Water and Sewerage Industry and Utilities Division of the Department of Commerce in a Business Service Bulletin available from the Department (cost 10 cents).

The Upper Colorado River will be tapped for a vast new water supply? Congress has now approved construction by the Bureau of Reclamation of three dams and two powerhouses in the Upper Colorado Basin. Their cost will be upward of $760,000,000. The projects are the 580-ft Glen Canyon Dam, a concrete structure on the Colorado just above Lee Ferry near the Arizona-Utah state line (here a 800,000-kw power plant is also contemplated); a 440-ft concrete structure in Flaming Gorge on the Green River in northeastern Utah; and Navajo Dam, a 335-ft rolled earthfill on the upper San Juan River in New Mexico. Eleven irrigation projects, aggregating 365,000 acres and included in the authorization, will receive water from the reservoirs.

Important supply and treatment programs are pending in other Western Hemisphere countries? Ontario, to the north of us, is embarking on a $2.5 billion water and sewage works program slated for completion in the next twenty years. Colombia, to the south of us, is receiving World Bank funds to initiate a multi-purpose TVA-type of development on the Cauca River near Calima.

Many cities are running out of water? Such a one is Denver, fastest-growing city in the West, which reports that if it can't find more fresh water its industrial growth must come to a halt by 1963. San Diego is seeking to solve its water problem by appointing top engineers and scientists to a committee to study conversion of sea water.

Our cities are finding new ways of solving the garbage-disposal problem? Detroit reports that its "on-the-site" disposal plan by household grinders is saving taxpayers $1,750,000 a year, and that the method pays an extra dividend in increased sanitation. Los Angeles' new attack on the waste-disposal problem by sanitary landfill is discussed in the lead article in this issue.

The American Water Works Association is seventy-five years old? The Diamond Jubilee Conference of this pioneer group in the field of water supply and sewage treatment is slated for St. Louis, May 6–11. Special trains from New York and Washington will take Eastern visitors to St. Louis, where the organization meeting was held in 1881. Incidentally, the AWWA has new headquarters at 2 Park Avenue, New York 16.

Charleston will soon have a huge industrial water supply project? A unique river-reshuffling project that will assure water-starved industries in the South Carolina Low Country 10 billion gallons of fresh water daily is being completed at phenomenally low cost. This interesting project is described on page 90.

The Ohio River Valley pursues its clean-up program? Louisville, last of the major cities on the Ohio to solve its pollution problems, is getting in line with plans for a central treatment plant. Cost of the plant and its interceptors will be about $16 million. Metcalf and Eddy are the consultants.

There are opportunities galore in the sanitary engineering field? New sanitary engineering research grants (67 of them) are announced by the U.S. Public Health Service for the period between July 1 and December 31. This program will be of special interest to young engineers in universities and research centers. Details from the Division of Sanitary Engineering, U.S. Public Health Service, Washington 25, D.C.

ASCE has taken action to advance sanitary engineering practice? The Society is one of the participating groups in the new American Sanitary Engineering Inter-society Board, which is empowered to certify sanitary engineers (January issue, page 75). The Office of the Board and its Certification Committee is at ASCE Headquarters. The first issue of the Sanitary Engineering Division's bimonthly journal is out.

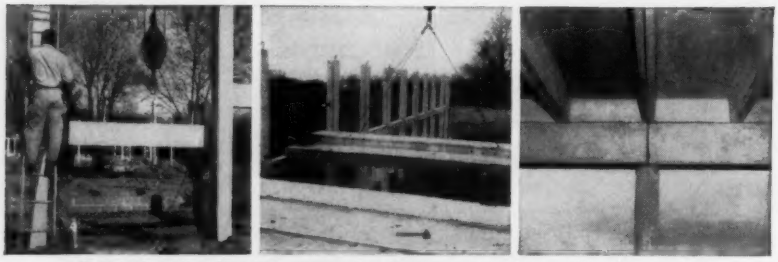
Housing Milestone

Precast 'Incor' Concrete Framing Cuts Erection Time and Cost on Big Philadelphia Housing Project

● Philadelphia, City of Homes, writes a bright, new page in the record of low-rent housing progress by providing comfortable, fire-safe dwellings for 412 families in its 500,000-sq.-ft. Liddonfield Housing Project, at a cost of less than $8. per sq. ft. of floor area.

Use of precast 'Incor' concrete columns, floors and roof decks for the 52 two-story buildings made possible assembly line speed in erecting the 20-ft.-wide units, ranging in length from 150 to 200 ft., at the rate of two a week.

All units were fabricated with 'Incor' 24-Hour Cement for fast, economical production and erection. You *know* what 'Incor'* will do . . . always dependable high early strength fits into well-scheduled, assembly-line production, assuring maximum output from the form investment . . . smooth-working mixes speed placing, improve appearance . . . sound reasons for insisting on America's FIRST high early strength portland cement. *Reg. U. S. Pat. Off.



First step is erection of two-story columns and spandrels. Next, 3-ft.-wide precast floor channel slabs are placed across building's full width. Right, under side of floor—smooth concrete surfaces only require painting.

PHILADELPHIA HOUSING AUTHORITY
LIDDONFIELD HOUSING PROJECT

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LIDDONFIELD ARCHITECTS OF PHILADELPHIA

Civil Engineers:
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General Contractor:
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CIVIL ENGINEERING

During the past five years, Los Angeles County has become increasingly conscious of two serious threats to public health—the growing air pollution and the spread of disease among hogs fed with uncooked garbage. In studying what the County Sanitation Districts could and should do toward eliminating these dangers, the Districts' engineering staff investigated the feasibility of various methods of refuse and garbage disposal. As explained in this résumé of the results of the investigation, the disposal of mixed refuse to sanitary landfills was favored. According to the recommendations, the Districts would own and operate the landfills and transfer and haul all rubbish to them, while the collection of the mixed refuse would be left to the local authorities.

PLANNED REFUSE DISPOSAL

for Los Angeles County

A M RAWN, M. ASCE, Chief Engineer and General Manager,

County Sanitation Districts of Los Angeles County, Los Angeles, Calif.

Los Angeles County is the only known metropolitan area in the United States where backyard incineration is widely practiced. The burning of combustible rubbish in the backyards of Los Angeles homes is a practice as old as the community itself. Conditions during early pueblo days did not require the public collection of rubbish because homes were widely scattered on large ranchos, and ample room was available for the burning or burying of waste materials.

With a scattered population, smoke was not a problem and the practice of backyard incineration continued to grow with the community. At present it is estimated that about half the rubbish created by the 5,000,000 people in the county is disposed of by backyard burning.

The backyard incinerator is a small single-chamber device usually having a cast-iron grate and a short screened stack. When such a unit is operated at a slow rate and fed with sma'l increments of reasonably dry rubbish, it may burn at a temperature high enough to prevent odorous smoke and fumes. However the usual method of operation is to stuff the chamber full of rubbish, grass trimmings, papers used to wrap meat and other foods, and heterogeneous refuse including leather, rubber, and cloth, and then apply a match. If ashes have not been cleaned from under the grate, combustion proceeds at a slow rate, yielding large quantities of gases of distillation. In too many instances the partially burned rubbish smolders for many hours.

The Los Angeles County Air Pollution Control District has studied the operation of backyard incinerators to determine the nature of their discharges. It has concluded that almost 100 tons of particles, along with significant amounts of objectionable gases resulting from incomplete combustion, are discharged daily to the atmosphere from almost a million homes in this area. In windy cities, such as Chicago and Detroit, yard burning would have very little if any local effect on the atmosphere except for possible annoyance to nearby neighbors. In the Los Angeles area, however, unusual topographic and meteorological factors periodically cause the area to be enshrouded in "smog." The situation is illustrated in Fig. 1.

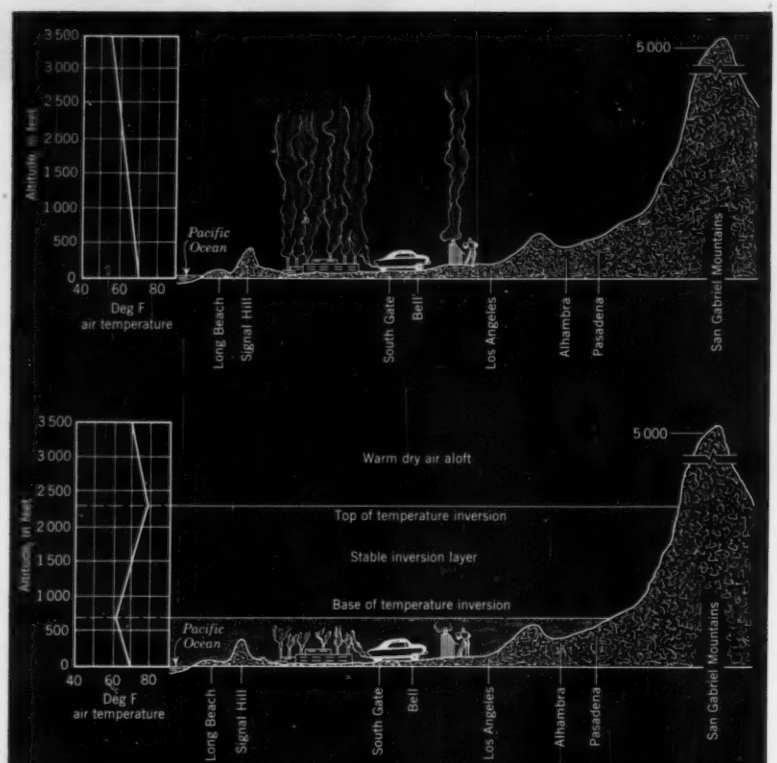


FIG. 1. Cross sections illustrate atmospheric conditions in metropolitan Los Angeles. In normal condition (above) where temperature decreases with altitude, convection currents carry contaminants aloft. Temperature inversion in middle air layer (below) creates a kind of air blanket which holds pollution close to the earth, producing smog.

Usually convection currents carry air contaminants aloft. However, the location is such that a stable inversion layer of air may occur and hold the smog close to the ground. The extent of the resulting air pollution at times makes the Los Angeles area one of the few metropolitan areas in the United States that cannot afford to permit backyard burning. As a result of these local meteorological conditions, pollutants released to the atmosphere must be kept to a minimum.

Because of the overwhelming evidence as to the unwelcome role of backyard incinerators in aggravating air pollution, the Board of Supervisors of Los Angeles County has resolved that the use of such incinerators must cease by 1957.

Municipal incineration

Much attention has been directed toward municipal incineration during the past decade because of population pressures. A very few large cities, notably New York, have turned to municipal incineration because problems of landfilling and transportation to landfills make incineration an attractive alternative for them. However, the University of California Technical Bulletin No. 5 (1951) stated, in a survey of 295 cities in the United States reported as using incinerators, that 30 to 40 percent of cities of less than a million population had abandoned their incinerators in favor of disposal in landfills, largely because of economic factors.

There are nine municipal incinerators in Los Angeles County: one each in Alhambra, Beverly Hills, Glendale, Pasadena, Pomona, Santa Monica and Signal Hill; and two in Los Angeles. These are excellent examples of conventionally designed and municipally operated incinerators but they are consistently discharging more than 0.4 grain of particulate matter per cubic foot of stack discharge, the limiting permissible amount set as a standard by the Los Angeles County Air Pollution Control District. Further, the Control District has stated that it desires to reduce the level of discharge still more. Without extensive modification, using costly air pollution control devices, such as electrostatic precipitators, municipal incineration cannot possibly approach the more restrictive standards that may be applied. When the cost of operating and amortizing these control devices is added to the already high cost of incineration, municipal incineration as a means of refuse disposal ceases to be economically feasible.

Actually, in the Los Angeles area, the primary consideration in municipal incineration hinges on a matter other than cost—the discharge of gases and particles to the atmosphere. A decade of experience with air pollution has made residents of this region extremely conscious of discharges to the atmosphere, resulting in a most stringent and restrictive air pollution code.

At the Conference on Incineration, Rubbish Disposal and Air Pollution held in Pasadena in December 1954, sixty engineers and scientists from municipalities in the United States expressed the thought that municipal and industrial incinerators should not be considered unless engineered to discharge suitable stack effluents. It was the collective opinion of the group, many of whom operated incinerators in their home cities, that the use of municipal incinerators should be viewed with concern in any area having the special meteorological conditions which lead to air pollution in Los Angeles.

Sanitary landfills

Techniques for the disposal of community wastes have closely paralleled levels of civilization. Ultimately all wasted or discarded refuse must find its resting place on or in the earth, in the sea, or in the air. Most waste disposal processes use the land for final disposal. A few discharge into large bodies of water. Incineration discharges all gaseous and suspended particles to the atmosphere, leaving only the ashes—a small fraction of the original refuse—to be buried in the ground.

Today, dumping is still the practice most commonly used in the United States and elsewhere, and extensive changes have taken place over the past decade in the methods of operation of disposal sites near urban areas. These changes have justified a new name for land disposal—sanitary landfilling.

In simple terms, the sanitary landfill involves a very much improved method of land disposal. The practice of refuse burial has been tailored to meet the exacting requirements of the most highly civilized communities through the application of public health and engineering techniques, involving careful filling, covering, and compaction; rodent, fly,

and odor control; and the prevention of fires. Not only is the method simple, but it is economical.

Vehicles specially designed for hauling refuse in bulk are in greatly increased use. Transfer stations may be established at which the collection vehicles discharge their loads for transfer to large-capacity motor vehicles. By this means the cost for long-distance hauling of the transferred refuse has been reduced to the point where landfill operations, once believed to be beyond the economic reach of many communities, are now entirely feasible. The innovation of transfer and long haul in specially designed vehicles makes it necessary to reevaluate the landfill as a means for disposing of municipal refuse.

Disposal by landfilling consists in placing and compacting refuse in natural or man-made depressions in the terrain, followed by periodic covering with a well-compacted layer of earth, slag, or gravel. A "sanitary landfill" is usually one where combined rubbish and garbage are taken, whereas an ordinary "landfill" is one accepting rubbish only. A D-8 crawler-tread tractor with a dozer blade can cover about 250 tons of refuse per 8-hour day on a landfill. A drag-line excavator with a $1^1/_2$-cu yd bucket can take care of a cut-and-cover site receiving up to 200 tons of refuse a day. Where cover material is hard to excavate, a ripper may be required. Where the cover material must be moved over 600 ft, a carry-all scraper will handle it economically. At any landfill site, an adequate water supply must be maintained to wet the rubbish, to improve compaction, to sprinkle access roads, and for fire prevention.

In the Los Angeles area, six canyon landfills are at present being operated. One of the best of these is operated by the City of Burbank. Although close to residences, the operation is conducted without complaint from the home owners. There is no nuisance from dust, noise, or insects. When completed, the filled area will be integrated into city-owned Stough Park.

The cost of operating sanitary landfills ranges from \$0.40 to \$1.00 per ton, depending in part on the ratio of the volume of inert cover material to the volume of compacted refuse. A ratio of 1:4 is required at all landfills operated under permits issued by the Los Angeles County Engineer. It is estimated that large-capacity sites operated by the County Sanitation Districts will have a total operating cost, including amortization of equipment, of \$0.75 to \$0.90 per ton of refuse delivered, including land cost and site development charges.

Parks, playgrounds, and ball fields are the most popular ultimate uses for landfill sites, although golf courses, parking lots, and airstrips have been built over landfills.

A comparison between the cost of the most favorable incineration operation and the least favorable condition for remote landfilling at points in the Districts' area within a 50-mile radius show that economy favors the landfill, with the additional advantage that no pollution will be contributed to the air.

Hog-fed garbage

Disposal of garbage by hog feeding in Los Angeles County is an example of taking advantage of the cheapest method available. Within the past five years, the County has become acutely conscious of the spread of disease among hogs fed on raw garbage. As a result, the practice has undergone a revolutionary change. Trichinosis in garbage-fed hogs, a disease transferrable to humans, has been one reason for the change. More serious has been the problem of vesicular exanthema (V.E.) in swine. This virus disease, peculiar to hogs, was shown to be transmitted principally through the feeding of uncooked garbage in a manner similar to the transmission of the parasitic trichinae. An epidemic spread of V.E. to 40 states in less than one year (1953) necessitated the slaughter of over 100,000 hogs at a cost well in excess of \$3,000,000.

Regulations of the California Department of Agriculture, which became effective on October 1, 1954, have virtually eliminated the feeding of raw garbage to swine. At 21 active hog ranches in Los Angeles County, about 1,100 tons of garbage per day are fed to 66,000 swine. About 90 percent is hauled in large-capacity transfer semi-trailers, in which the garbage is subjected by direct steam injection to boiling temperatures for 30 minutes.

Although the hog-raising industry represents some benefit to the county, it requires separate collection of garbage, usually twice weekly. The saving in collection costs that could be effected through the collection of garbage combined with rubbish is very attractive. Wrapped garbage combined with other refuse requires collection but once weekly, which would save about \$3.50 per ton of garbage collected. The average cost of disposal of the mixed garbage and rubbish may be about \$1.50 per ton. It can be demonstrated that the economic benefit to the community from the feeding of garbage to hogs is negligible.

Kitchen garbage grinders

The practice of feeding garbage to hogs will not alter the trend toward the universal use of garbage grinders and the eventual elimination of garbage collection. In the Los Angeles area, there has been an almost explosive growth in the use of garbage grinders for disposing of kitchen wastes in homes, restaurants, hotels, and food processing establishments. The tens of thousands of homes using garbage grinders in 1950 have become hundreds of thousands in 1956.

Sewers in many new subdivisions of Los Angeles County are now carrying all the garbage produced. Garbage collection trucks are completely unknown in such communities. There are an estimated 500,000 electric food-waste disposers in use in Los Angeles County. That is, one-third of the homes have installed grinders. At the present rate of sales, the industry estimates that in ten years three out of every four homes will be using domestic garbage grinders, a proportion not equaled in any other metropolitan area in the world

No significant modification in sewage treatment processes has been found necessary because of the presence of ground garbage in the influent. Ever increasing amounts of floatable scum (grease) are being removed from sedimentation tanks at the District's treatment works, but it decomposes readily in the sludge digesters and is considered a normal component of the sewage now being collected and treated.

District-conducted studies indicate that the increase in per capita water use due to grinders is between 1 and 2 percent of the average sewage flow of 100 gal per capita per day. Some difficulty may develop in the upper reaches of residential sewers because the low flow may be unable to resuspend accumulated garbage debris. The most logical solution appears to be a scheduled routine of flushing these lateral sewers.

Central garbage grinding

Central garbage grinding affords a convenient disposal method where garbage must be collected separately and is not disposed of more economically through hog feeding. St. Louis has two central garbage-grinding stations. Richmond, Ind., and Canton, Ohio, also have established garbage-grinding stations at their sewage treatment plants. A central grinding station is a simple structure consisting of a storage pit to permit rapid dumping from collection trucks; a conveyor system to carry the garbage to sorting tables and then to grinders; electrically driven garbage grinders of sufficient capacity; a settling chamber for removal of grit and metal particles; and finally, an outlet to a trunk sewer.

Grinders having capacities up to 50 tons per hour are available. Plants with capacities of 50 tons per day would cost about \$1.30 per ton of garbage, and the additional cost at the primary treatment works would be about \$0.50 per ton.

The Los Angeles County Sanitation

Districts' Joint Disposal Plant, at Wilmington, which has been in operation since 1928, provides primary treatment, separate digestion, air drying of sludge, and disposal of effluent by ocean outfalls to the Pacific Ocean at White Point. This plant treats the sewage from a population of 2,525,000 people living in an area of 590 sq miles.

Experience shows that ground garbage may be introduced into the sewers at the rate of 2 tons per hour to each cubic foot per second of flow in the sewer. Although this represents an increase in total solids of 300 to 400 percent over that in the present sewage, the total solid content would still be only 0.36 percent by weight. That is to say, the sewage would still be 99.64 percent water.

Studies show that a more economical solution to the garbage problem than central grinding is to collect and dispose of it in combination with rubbish, using the sanitary landfill method.

Composting is probably the most intriguing of all the waste disposal processes since it proposes to convert wastes having negative value into a product having real value. Research and investigation for a better understanding of the process continue. Composting of municipal organic refuse can be accomplished in from 10 to 14 days in open-field windrows. With mechanically controlled composting equipment, bacterial decay can be accelerated to produce a useable compost in 2 to 3 days. For high-rate operation, the mixed garbage and rubbish should be ground to pass a $1/2$-in. screen. The cost of mechanical composting is about $7.00 per ton of garbage-rubbish processed. Because the market for compost is not assured, it would not be good judgment to adopt a process which depends for success upon the sale, or gift, of many hundreds of tons of compost daily. It is concluded that composting should not at this stage be selected as the sole means of disposing of the municipal refuse of the area.

Grinding rubbish and disposing of it to existing sewer systems has been proposed as an attractive means of solving the difficult disposal problem. Insufficient experimental research has been conducted to determine the feasibility of this process. It would require rugged grinding equipment and expensive major revision to sewage treatment plants. Preliminary estimates indicate a cost of $1.85 per ton. Further study of this method is needed.

Disposal by dumping at sea is often suggested and has been tried. New York barged its refuse seaward beyond Sandy Hook from 1890 to 1930, but ocean currents and tides swept it back on to the New Jersey shore. A U.S. Supreme Court decision in 1934 put an end to this practice. Oakland, Calif., dumped as far beyond the Golden Gate as the Farallon Islands, more than 30 miles from shore, but winds and tides

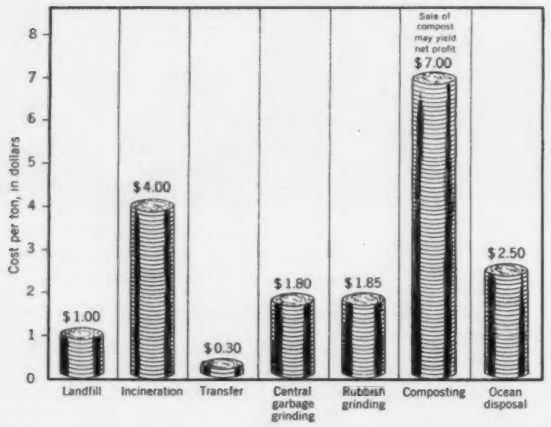


FIG. 2. Typical 1955 costs for various types of waste disposal in Los Angeles area are compared. Costs of collection and haul, or possible revenue from sale of end products, are not included.

Transfer vehicle of type used in Chicago for transporting refuse from Loop area to Lake Calumet landfill, unloads refuse by a moving floor conveyor actuated by power take-off from tractor engine. Trailer has capacity of 66 cu yd.

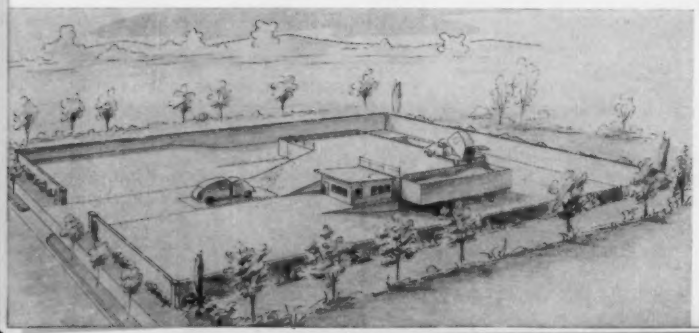


FIG. 3. Proposed transfer station for 200 to 250 tons per day of refuse and garbage includes features successfully used in a number of Southern California cities. Where cost accounting and billing are required, weighing facilities will be provided. Design provides rest-room and change facilities for personnel, and wash racks for vehicles.

created unpleasant beach conditions by carrying refuse back to shore. The practice was abandoned by Oakland in 1942.

For a one-way ocean haul of 50 miles from Los Angeles Harbor, the cost of ocean disposal is estimated at $2.50 per ton, to which must be added the cost of an average transfer-truck haul of 15 miles at $1.45 per ton, making the total cost for ocean disposal about $3.95 per ton. The recreational and economic value of Southern California beaches demand positive security from such shore-line pollution as might result from ocean disposal of refuse.

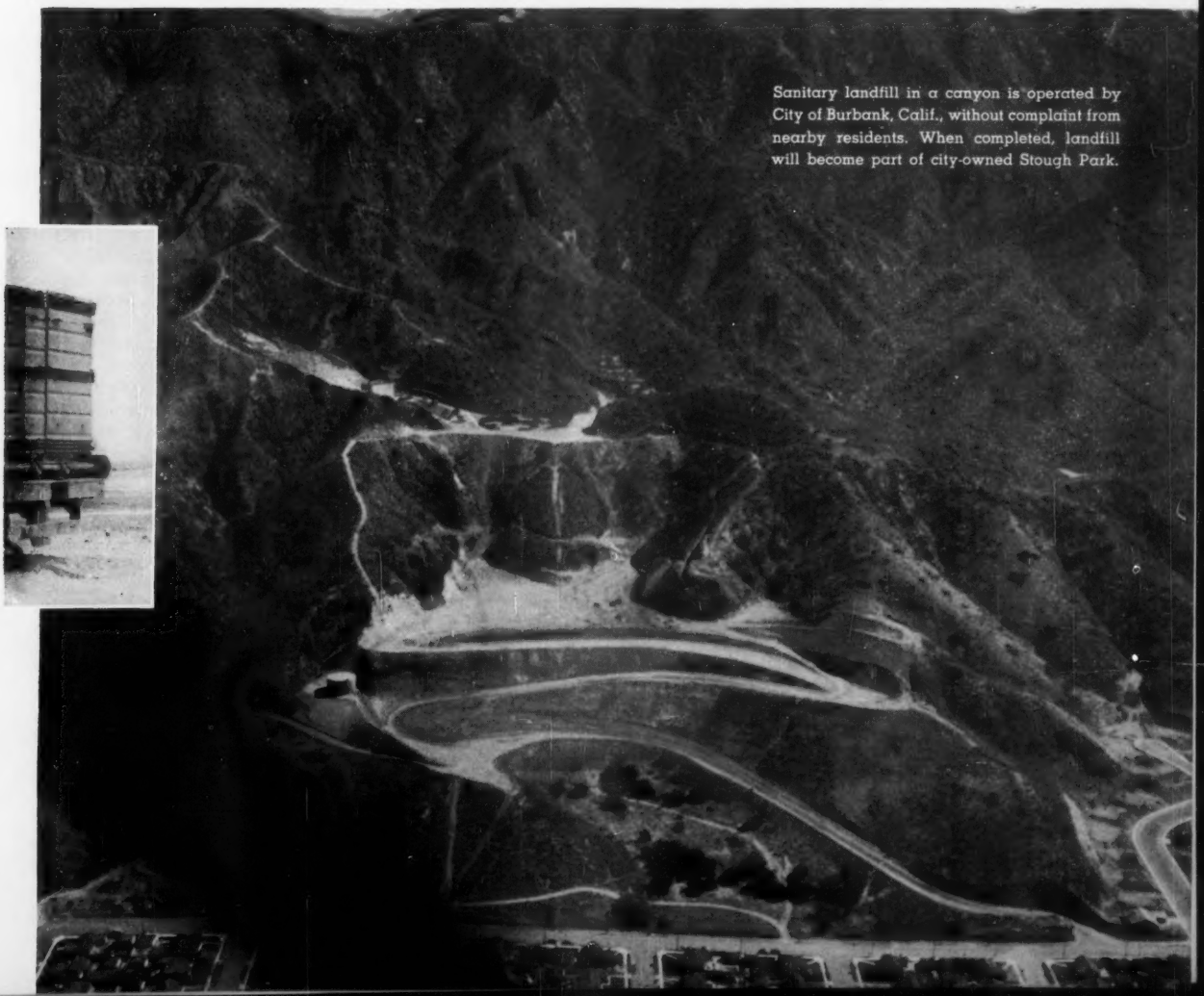
Disposal costs compared

Refuse-disposal costs by the several methods here presented are compared in Fig. 2. These costs were determined for the Los Angeles metropolitan area, but are representative for use in other places where environmental conditions are similar. The landfill cost represents carefully controlled operation by municipal or other public bodies. Incineration costs are average, but may increase with the imposition of more restrictive standards for air-pollution control. Transfer costs plus costs for haul must be added to the landfill costs when disposal is at a distant site. Costs for garbage and rubbish grinding are based on experience observed elsewhere. Ocean disposal costs are based on experience at Oakland, Calif., and New York, N.Y.

It appears that a program of refuse-transfer stations and sanitary landfills should be started promptly. In five areas of the County the immediate construction of a transfer station with disposal at nearby landfills would be economical. Such transfer stations would have an initial capacity of 200 to 400 tons per day and would cost from $50,000 to $250,000 each. See Fig. 3. Capital for the acquisition of land, and for construction and operation will come from a five-year levy on taxes of the Districts (2 cents on each dollar of assessed valuation). Capital recovered through use charges made at disposal sites, plus the collection of future tax levies, will permit construction of the remaining transfer stations as needed at later dates. With landfills operating at 500 tons per day, the charges for *disposal* will vary with the sites from $0.60 to $0.95 per ton delivered. Transfer and haul costs will vary with the distance—$1.25 per ton for 10 miles, $1.65 for 20 miles, and $2.20 for 50 miles.

Already critical conditions have developed as the result of uncoordinated methods of refuse disposal. Modest expenditures will initiate an economical program leading to landfills for the disposal of wastes.

The writer wishes to acknowledge the considerable contribution of F. R. Bowerman, A.M. ASCE, Division Engineer, County Sanitation Districts of Los Angeles County, to the investigations on which this article is based.



Sanitary landfill in a canyon is operated by City of Burbank, Calif., without complaint from nearby residents. When completed, landfill will become part of city-owned Stough Park.

PUBLIC UTILITY FINANCING—

When we engineers consider the question of revenue or tax bonds for financing water and sewer improvements, our first reaction is often to place the responsibility for deciding such matters squarely on the shoulders of government authorities and their fiscal advisers. It is true that many factors falling outside the engineer's field are most pertinent to such decisions. But are these factors—such as comparative interest rates, bond ratings, maturity schedules, market conditions and the relationship of utility financing to other governmental functions and obligations—the really basic and primary concepts determining revenue or tax financing? They may not be, and in this answer lies an important phase of our professional responsibility as civil engineers.

Among engineering societies, the American Society of Civil Engineers can boast of the broadest field of engineering coverage. I do not mean physically, but in range of interest and activities. A moment's reflection on the position of the civil engineer in today's society will make it evident that, in this era of specialization, he not only can offer an astonishing range of proficiencies in specific structural, hydraulic, sanitary, and even mechanical and electrical fields, but he also can walk with the leaders who plan on a broad basis for supplying the needs of mankind.

The civil engineer is an important member of the group that organizes and implements governmental and management procedures and weighs the economics involved. Through it all, because he is best informed, he is not infrequently the lone watch-dog over the rights of the public and the equities between the parties concerned. Thus, the civil engineer, through the breadth and perspective which are his because of his training and his strategic position in modern society, finds himself not only employed for engineering services highly important to the public but also sought out for innumerable civic and community activities which are equally vital.

Equities and rights involved

Financing of public works and its impact on the citizenry move into the area of equities and rights and fair play so directly that these matters must be of primary concern to the civil engineer. His responsibilities do not stop with the planning, construction, operation, and management of the facilities so as to safeguard the public physically. The realism of economic progress, social betterment, and again fairness must also be his concern.

Most of us with experience in water and sewage works know that their financial underpinning leads into a myriad of problems bearing on fairness to the public. Authorities and engineers everywhere are constantly wrestling with methods for the fair apportionment of charges for water and sewer service, and these struggles have fostered a wealth of published articles covering all manner of solutions in various localities. It is almost axiomatic that bodies politic and utility authorities can never build reserve funds for pay-as-you-go improvements. Consequently installment purchasing through bond issues is a familiar procedure for public works.

Aside from collateral, the fundamental considerations for bond financing begin with the ability to pay and the source of that ability. The source, being the taxpayers and utility customers, is too often considered solely in the light of aggregate ability to pay without proper allocation of charges. A panel discussion on "Rethinking Water Rate Structures," published in the November 1949 issue of the *Journal of the American Water Works Association*, included this statement:

"A...review of the existing situation ...suggests an amazing confusion about the basis for their determination and a wide diversity not only in existing rates, but in the schedules being currently prepared by leading water works engineers."

The same may be said of sewer rates and sewer-rate structures. Rare are the instances in which a fundamentally sound balance is maintained between tax levies and water and sewer charges for supporting utilities.

In the 1951 spring issue of the *Ohio State Law Journal* there appeared a joint report of committees of ASCE and the Municipal Law Section of the American Bar Association, on "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works." The fundamental principle on which this group concluded it should base its study was:

"The needed total annual revenue of a water or sewage works shall be contributed by users and non-users (or by users and properties) for whose use, need, and benefit the facilities of the works are provided approximately in proportion to the cost of providing the use and the benefits of the works."

The scope of study of this group was quite comprehensive in recognition of a general situation characterized by fundamentally unsound rates and rate structures. Its findings and recommendations were generally valuable and should have found widespread acceptance. But so far, in the writer's experience, they have not significantly dented the widespread inequities to which they called attention. Who or what is to blame? In some cases, it may be legal limitations, but rarely are efforts made to change these. In most cases, the fault lies in varying degrees with the political administration, its fiscal advisers and last but certainly not least, with the engineer in charge. This engineer is nearly always a civil engineer.

The sponsorship and financing of water and sewer improvements, from the customer rate structure to the saleability of bonds in the money marts, is the subject in some aspect or other of many published works. A cursory review over the past few years reveals

a professional responsibility

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articles on solutions in all parts of the United States, under all sorts of political subdivisions. State laws are such as to create differences in sponsoring entities. Aside from municipalities, we find authorities and districts of all kinds, with variations such as "water districts," "joint meetings," etc. While the trend is toward greater use of revenue bonds, ad valorem tax bonds remain very much in the picture.

Diversion of revenues

Under municipal sponsorship, the treatment of and attitude toward the utility departments likewise vary widely. A sizable city in Texas operates its water department as part of a general-fund operation, with water-system revenues not only supporting system operations and debt service but also providing substantial sums for other municipal functions. In a similar category are the occasional municipalities that derive a very large part of their total income from their electric distribution systems.

It is virtually impossible to devise a rate structure based on a "use" or consumption charge which is fair to the user under these circumstances. In most cases there is a minimum monthly charge on each meter which purports to apportion fairly not only customer-accounting and similar costs having no bearing on consumption, but also certain fixed charges for pro rata capital investment. But rarely does the rate structure take into account the proper apportionment of such costs as that of providing fire protection in a water system. A brewery, by using a large quantity of water, may not only be paying for fire protection for a cotton warehouse but, along with domestic customers, may be substantially subsidizing fire protection for a great many other commercial and industrial establishments whose use of water is comparatively low.

How should the water and sewer utility modify its charges to correspond with values offered? All types of approaches are used, customarily embodying one or several of the following:

A. Water charges
   1. Flat rate
   2. Front-foot benefit assessment
   3. Meter charge, service charge, readiness-to-serve, or minimum charge
   4. Sliding-scale rate based on use (quantity block)
   5. Fire protection charges of all types
   6. Ad valorem tax levy

B. Sewer charges
   1. Service charge
   2. Front-foot benefit assessment
   3. Ad valorem tax levy
   4. Charge based on volume of water use
   5. Charge based on number and kind of plumbing fixtures
   6. Charge based on strength of sewage or waste (industries)

Obviously the use of revenue or tax bonds, or combination bonds, hinges on the basic sources of funds committed to the support of these services. Far too often the need for additional financing by bond issues is met by merely increasing the old rates or levying additional ad valorem taxes without examining the fundamental and original inequities which are thus being further compounded.

Civil engineers, collectively as a small but informed segment of the community, and individually as employees or consultants of political subdivisions, have a responsibility to the largely "unsuspecting public" which transcends lethargy and the "easy way out" in this, one of the basic areas of their profession. Collectively by states, and on a national scale, we must seek to alter and improve the concepts of public contributions—not necessarily by adopting standardized rate structures but by enunciating fundamental principles of fairness. Individually we must help to ease legal restrictions which are in conflict with these fundamental principles of fairness.

The engineer has the public's trust

Just what position does an engineer assume under an assignment involving water and sewage works? Aside from the solution of the basic engineering problems in the preliminary phase, he is often called upon to prognosticate the rate of growth and certify that, under various qualifying conditions, the net revenues, however derived, will meet principal and interest payments with a comfortable margin. If he accepts a condition involving inequities in the derivation of these required revenues without strongly recommending that such inequities be corrected, he is taking the easy way out and not keeping faith with the public.

Just as much professional integrity is demanded here as in his performance of the engineering assignment. Investors in municipal bonds often like to see the bond program set up so as to require an engineer's certification on substantially every transaction from beginning to end, and frequently they want periodic reports throughout the life of the bonds on all factors affecting the well-being of the utility.

All these things are indicative of the great public trust in the engineer which he cannot thrust aside. Regardless of our material gains or lack of them, and our fame or anonymity, our true successes as individuals are determined by the dimensions that frame our lives—narrow and shallow or broad and deep. We can seek greater successes by shouldering our professional responsibilities to the full or we can refuse them and become merely technicians.

(This article is an abstract of the paper presented by Mr. Beard at the ASCE Dallas Convention, before the Sanitary Engineering Division session presided over by Gordon W. Parkhill, secretary of the Texas Section's Sanitary Engineering Technical Group.)

Nepal's water supply

K. C. LAUSTER, M. ASCE

In August and September 1954, the author was a member of the American emergency team sent to East Pakistan at that government's request to help combat the effects of unprecedented floods on the nation's health. On his way home, while in New Delhi, India, he was requested by officials of Nepal to visit that country relative to problems caused by flood damage to water supplies. He was recently assigned to the Federal Civil Defense Administration at Battle Creek, Mich.

Nepal, sometimes called the Switzerland of Asia, is roughly 100 miles wide and 600 miles long. In this mountain setting live some 10 million people under an independent government which has never been subservient to another power. Until six years ago, it was an absolute monarchy, but it is now called a constitutional monarchy. Efforts toward educating the people are just beginning. At present, only about one or two percent are literate.

The southern part, which extends into the Gangetic Plain, is known as the Terai. The foothills are called the Sub-Terai. The rest of the country is mountainous, containing the highest peaks in the world, the Himalaya. In one of the valleys found among the mountains is Katmandu, the capital of Nepal. Katmandu Valley is about 15 miles long and 10 miles wide, hemmed in by mountain ranges up to 12,000 ft in height, with

1. Open dug well is typical water source in outskirts of Katmandu.

2. Nepalese improved open dug well has counterbalanced pole and chain for drawing up pail, wood grill as safety measure, and platform for laundering clothes.

3. Water plant under construction in Katmandu has as its primary purpose removal of mica, which is blamed for severe intestinal upsets and bleeding. Roger Sheppard and Rana Kailash Shumshere look it over.

4. This street scene is typical of heart of Katmandu, capital of Nepal. City and immediate vicinity have population of 140,000, mostly supplied with water by street hydrants, to which women come to fill their jars.

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problems reviewed by an American engineer

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passes at about 7,500 ft through which access is afforded by airplane, on foot or horseback, and by ropeway (for freight only). The climate is practically ideal. Lying only a short distance above the Tropic of Cancer, but at an elevation of 5,000 ft, Katmandu suffers no temperature extremes. During the summer, temperatures rarely exceed 85 deg F, and during the winter, 35 deg F is about the minimum. Normally, during the winter, the temperatures drop to around 45 deg F at night, and reach around 70 deg F during the daytime. Protection against freezing is never necessary.

Most of the 300-odd automobiles in the valley have been hauled in by 100-man coolie teams. The ropeway can handle items up to about 500 lb only. In recent years, small cars have been brought in by DC-3's, which are standard equipment for the Indian Airlines serving Katmandu.

Katmandu and immediate vicinity has an estimated 140,000 population. Water for these people is obtained from three general sources—the Balaju supply, the Maharangunj supply, and a relatively small supply in the southwestern part of the metropolitan area.

The Balaju supply, the largest, comes from three dams located about six miles from the central reservoir site, where a filtration plant is under construction. A 6-in. pipe brings the water by gravity from each of these dams to a point about three miles from the filtration plant and at an elevation of 50 ft above the plant. From this junction, it flows through a 12-in. pipe to the filtration plant. The normal flow is 3.25 cu ft per sec. This flow is reduced by one-third during the dry months of April, May, and June. An additional source of 0.25 cfs is being developed, which will be brought directly to the filtration plant through a 6-in. pipe. This will bring the total to 3.75 cfs, or about 102,000 gal per hour.

The filtration plant, which has been under construction for about five years, is rated at about 104,700 gal per hour. One of its principal functions will be to remove the mica which is reported to be generally found in water supplies throughout this area. The mica is said to be extremely irritating to the intestinal tract of humans, causing bleeding and severe diarrhea. Some valves and piping remain to be installed in the filter gallery. Aside from this, the principal remaining items are the 75-hp washwater pump and motor, which have been in transit from Calcutta for the past two years. They are now at Amlekhganj, awaiting transportation over the mountains, presumably by coolies, since they are too heavy for the available planes.

The Maharangunj supply, reported at 1.5 cfs, or 25,000 gal per hour, is similar to the Balaju supply. It likewise has a filtration plant in a similar stage of construction. These two supplies provide most of the water for the area, and serve an estimated 100,000 population, mostly by street hydrants to which people come to fill their jars. This means 26.4 gal per capita daily, which should be adequate for this type of use if wastage is curbed.

The third water supply comes from springs through four miles of 4-in. pipe, with a drop of 350 ft. This serves a small area, including Rabi Bahwan, where the Americans live.

Since all the water flows by gravity from the mountains into the city, one might expect the supply to be reasonably dependable. This would be true except that, during the dry season, water is at a premium and is essential to growing crops. Farmers living near the pipelines sometimes break open a pipe and allow the water to run on their fields. This of course interrupts the supply in town until the leak is repaired, and the wasted water reduces the amount impounded at a time when it can least be spared. Also, the total amount of water available during the dry season is about one-third less than normal.

While much can be done to improve the water system and to provide more adequate distribution, the principal problems are: (1) to eliminate waste caused by hydrants without valves, leaky valves, broken pipes, and the like; (2) to remove the mica; and (3) to increase the quantity of the supply, particularly during the dry season. This might best be done by wells which can be used as needed to supplement the surface supply. Completion of the present filter plants should solve the second problem. A major obstacle is the delivery of the wash-water pumps and motors. It was suggested that, if they cannot be brought across the mountains, washwater tanks be substituted.

In the rural areas and villages, water is generally obtained from springs, dug wells, tanks, or streams. Some springs observed in the Katmandu area had been developed in excellent fashion, from the sanitary standpoint, and provided very good water. The dug wells, generally 6 ft or more in diameter, have no top, and water is drawn by pail and rope. Obviously the quality of this water is affected by the amount of debris that falls into the well and the condition of the pail and rope used to withdraw water. Since each woman brings her own pail, and may carry or drag the rope, little imagination is needed to predict the water quality.

Depressions in the ground which capture surface runoff or overflow from springs are called tanks in Nepal. We would probably call them ponds, dugouts, or pits. Water in these tanks is used for washing clothes, for bathing, and for other purposes too, if they are the only sources of water available. Some of the lower castes are prohibited from using wells, and are thus required to use the tank water for all purposes, including drinking. Rivers are often used for water supply, and may be quite satisfactory when there is adequate flow to provide dilution for waste, but during the dry season, flows diminish and at times people dig holes in the river bed in an attempt to obtain water.

As one would expect, with no organized method of excreta disposal, filth-borne diseases are rampant. Cholera is the principal killer, but typhoid, dysentery, and the diarrheas abound. There is so much fear and superstition about cholera that many of the doctors refuse to go into villages where

cholera has been reported. We find this difficult to understand, in view of our knowledge that, of all the filth-borne diseases, cholera is one of the most vulnerable to improved sanitation.

A great many of the dug wells could be made completely satisfactory, from the sanitary standpoint, by cleaning to remove foreign matter, improving the drainage in their immediate vicinity where necessary, and providing a tight cover with one or two pumps installed in the cover. For wells of heavy usage, or in locations where alternate sources are not to be found, two or more pumps are suggested for improved dependability.

Some tube wells have been installed in the Terai. They are probably the only sanitary-type wells in the country. They are generally $1^1/_2$-in. pipes with a 12-ft-long gauze screen in the water-bearing formation. Depths vary from 30 to 250 ft. Usually, at depths of less than 80 ft, the water has a bad taste, probably due to excessive iron. The wells are generally artesian, and can be pumped with a suction pump. Suction pumps with a cylinder of $3^1/_2$-in. diameter are used, and seem to work fairly satisfactorily, except that they are subject to high maintenance. The leather cups and other moving parts wear out fast, and many pumps operate with a jerky motion which contributes to the wear of the metal parts. Some reasons for this condition may be: too fine a screen, or poor screen design; too large a pump diameter for the size of the well; too high a suction lift; inadequate design of wearing parts for type of use; and poor quality of leather cups. Experiments are needed to determine which factors are responsible for the present unsatisfactory conditions, and to improve the design of both the wells and the pumping equipment.

The cost of putting in one of these $1^1/_2$-in. tube wells at Tarwanipur in the Terai was as follows:

Item	Rupees
Screen, $1^1/_2$ in. × 6 ft, two @ 45 rupees each	90
Pump, Maya No. 6, one	25
Pipe, of $1^1/_2$-in. diameter, 140 ft @ $1^1/_4$ rupees per ft	245
Platform, lump sum	25
Cartage, lump sum	25
Drilling, 152 ft @ 1 rupee per ft*	152
Total cost, in Indian rupees	552
or approximately	$175

* For wells less than 100 ft deep, drilling costs are $1^1/_2$ rupees per ft.

Obviously, there is much to be done in improving living standards in Nepal. It is equally obvious that any improvement in general conditions and standard of living must be based on improvements in sanitation; otherwise all efforts will fail.

NUISANCE-FREE OPERATION for new

WILLIAM A. XANTEN

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Before discussing in detail the District of Columbia's new Mt. Olivet incinerator, it may be of interest to give some background information on the overall refuse disposal problem of the nation's capital.

Of local significance is the predominantly residential, institutional and federal characteristics of the District of Columbia, with its rather large transient population and a dearth of available low ground for landfill purposes. Surrounding areas of Maryland and Virginia have been rapidly developing to the point where they now constitute densely populated metropolitan centers with landfill problems of their own.

Local regulations, in effect without substantial change since the beginning of the century, require the separation of refuse at the source into three major categories: garbage, defined as waste food only; ashes, including coal ashes, incinerator residue, and non-combustible yard refuse; and trash, which includes tin cans and bottles and in effect all combustible material generated on the premises including leaves, grass, Christmas trees, and discarded furniture.

With the exception of garbage service, collection by the municipality is limited to private homes and small apartments. Under special permits issued annually, garbage from most hotels and restaurants is collected by pig feeders operating as far as 90 miles away. Garbage now represents only about 3 percent of the total volume of solid wastes of the community. Trash, ashes, and incinerator residue from commercial, industrial and federal establishments are handled for disposal without charge by the municipality. In fact the municipality offers and maintains rigid control over disposal facilities for practically all solid wastes produced within the District of Columbia.

Incineration practiced since 1932

As far back as 1926 a decision was made that reduction in volume by incineration of combustible refuse—which in our language meant "trash"—and street sweepings was an essential requirement to conserve existing and potential landfill areas. Two trash-burning incinerators of 170- and 425-ton daily capacity were designed by Metcalf and Eddy of Boston, Mass., and placed in operation in 1932. [See article by H. P. Eddy, Jr., M. ASCE, in CIVIL ENGINEERING for December 1932.]

By 1940 both plants were unable to keep pace with the ever-increasing production of trash, and controlled open-burning procedures were instituted to deal with the excess. By 1954 an average of 1,200 truck loads per day were being handled in this manner and the two plants represented only 30 percent of the necessary capacity to deal with the situation. During the period from 1940 to the present nearly 35,000,000 cu yd of combustible trash was disposed of by open burning, the residue being further reduced by removal of drums, tin cans, and all miscellaneous ferrous metal by electro-magnets. The fill volume remaining for final disposal approached 600,000 cu yd, a 98 percent reduction in volume.

Since 1945, the city's per capita pro-

incinerator in Washington, D. C.

Trucks enter Mt. Olivet Incinerator by ramp at south end. Space under ramp is utilized for general storage and for gravity storage of abrasives and chemical for ice control.

duction of trash has more than doubled, and now stands at 1,100 lb per capita per year. About one-third of this production comes from private homes and small apartments. The total annual production, excluding street sweepings, amounts to 472,511 tons, or 4,590,634 cu yd. Household trash averages 230 lb per cu yd, or 9 cu yd per ton, whereas commercial and Federal Government material is somewhat lighter, averaging 200 lb per cu yd or 10 cu yd per ton.

Goals of incinerator design

In designing plants for the incineration of this type of refuse, special consideration must be given to adequate provisions for handling such light and highly combustible material. Drawing on the experience gained over the years in operating the existing two incinerators, and taking advantage of the exceptionally competent services of the District of Columbia Architects' Office, detailed plans and specifications were prepared by the municipality. The plans were subjected to review in 1945 by Greeley & Hansen of Chicago, who were also engaged to make special studies on waste heat utilization and fly-ash control. Two important determinations resulted: first, that among other considerations, the strategic location selected for the incinerator, and the existing low rate for power (9 mills per kw) ruled out waste-heat utilization; and second, that the proposed somewhat radical design of combustion chambers and flues would achieve satisfactory fly-ash control under natural-draft operation.

Fundamentally, there is very little that constitutes new concepts of design in the District's Mt. Olivet Incinerator. (See Fig. 1.) Basically the furnaces are similar to other rectangular, four-cell, batch-fed units of mutual-assistance type. The plant is equipped with pit and cranes for 24-hour operation, and residue is discharged by gravity through quenched-ash hoppers directly to trucks in a well-lighted and ventilated ash tunnel. The features worth noting are those which represent an attempt to produce from these combinations a plant which operates nuisance free, one which attains full daily capacity without "pressing," and with a minimum of operating personnel; and last, but perhaps not least, a plant in which vital equipment failures do not knock out the entire operation and refractory maintenance is at a minimum. These features will be discussed one by one to emphasize their extreme importance to the general efficiency of any refuse incinerator.

With respect to nuisance-free operation, the plant is fortunately located in an interior corner of an L-shaped, 6-acre plot of ground with separated incoming and outgoing roadways. Abutting on

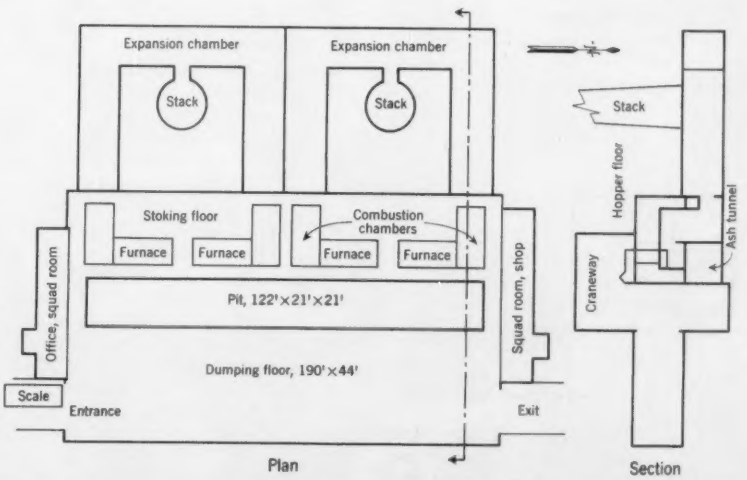
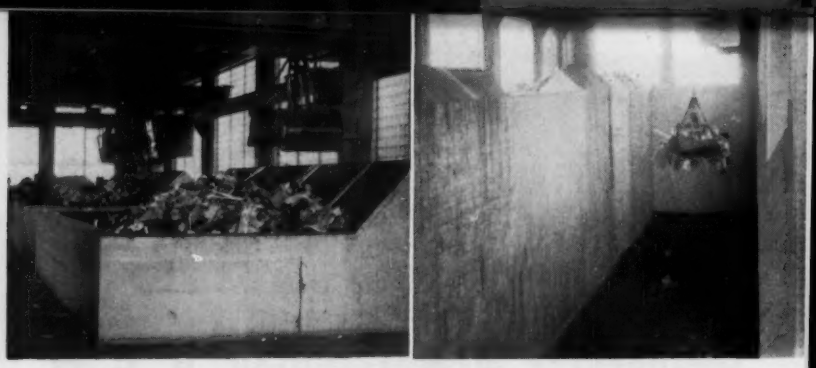


FIG. 1. Plan and cross section of Mt. Olivet Incinerator show arrangement of units to provide good natural draft and trapping of fly ash.



Collection trucks dump trash into pit from right-hand side, as seen in photo at right. Thence three cranes pick it up and charge hoppers seen in photo at left. These hoppers are directly over furnaces.

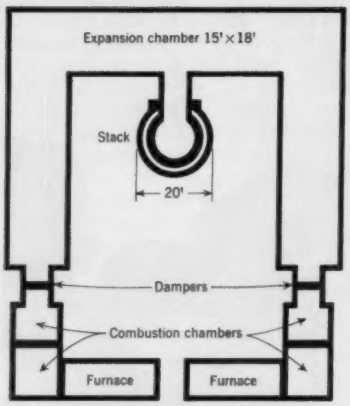


FIG. 2. Detailed plan of a two-furnace unit shows generous size of expansion chamber and breeching. Although perhaps larger than required, these features in the long run provide cheap, foolproof, and nuisance-free operation with natural draft.

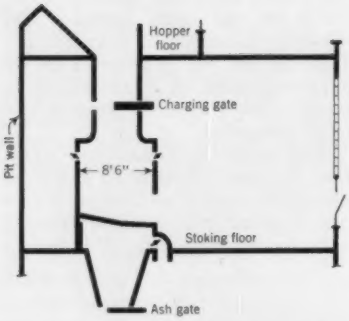


FIG. 3. Vertical cross-section through furnace indicates relationship of pit and furnace to stoking floor. Light and ventilation are good at stoking-floor level.

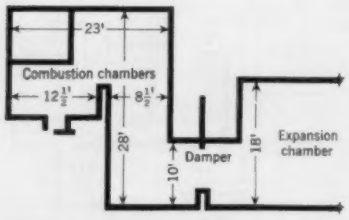


FIG. 4. Vertical section through combustion chambers shows arrangement which permits "reversal" of furnace and 28-ft plunge of combustion products to base of ash tunnel for run to stack.

the plant to the west are the Division's major garage and shops and a municipal passenger-car testing station; to the north, a warehouse and garage district; to the east, a cemetery; and to the south, a large housing development. Truck traffic in the vicinity was not appreciably increased in that much traffic to the landfill area previously fed through the same section. Incidentally, the round-trip saving in mileage (4 miles) for the traffic now using the incinerator totals about 500,000 miles annually.

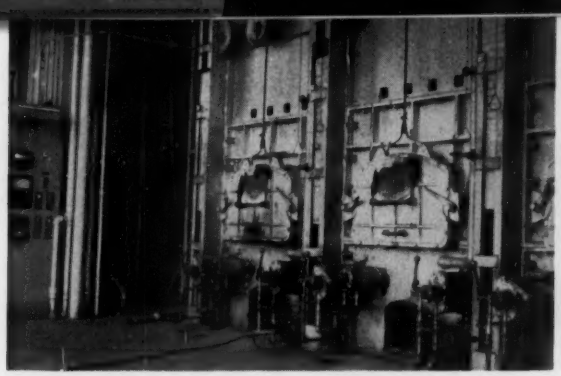
No complaints of fly ash

Since the plant was placed in operation in March 1955, no complaints of fly ash have been received. Although no precise stack-loading tests have yet been made, it is anticipated that such tests will confirm our observations and experience that proper provisions for impingement, sedimentation, and trapping under balanced natural-draft operation can and does prevent nuisance-type stack emissions. The main combustion chamber of each unit is equipped with a hopper in the ash tunnel for periodic removal of accumulations of fly-ash during the week. The plant is equipped with a vacuum system for handling all flue and expansion-chamber accumulations at the end of each week, and outlets in stair-wells and other critical locations aid in maintaining plant cleanliness. Since the plant has been in operation, an average of 605 cu ft of fly ash has been removed each week from the flues and expansion chambers alone. Quantities removed from the combustion chambers are slightly less, totaling some 490 cu ft. It should be noted that the expansion chamber and flue volume provided exceeds that of any known incinerator plant, amounting to 209 cu ft per ton. (See Figs. 2, 3, and 4.) Equivalent space in the previously built Plants 1 and 2 amounts to only 27.8 cu ft per ton.

Because of this volume and the long run provided (112 ft) between the base of the damper and the stack, a temperature drop of approximately 50 percent results. Experiments with additional baffling in the flues leading to the south stack have not produced any noticeable increase in the quantities of fly ash trapped. I am inclined to believe that maximum results have been attained with the dry system and that the installation of sprays or other forms of mechanical treatment is unnecessary.

Precise stack-loading measurements require costly and complicated procedures. The free exchange of information regarding the relative efficiency of fly-ash control at refuse incinerators would be served if it were possible to establish a rule-of-thumb which could be applied with some degree of accuracy. It is suggested that the total weight or volume of material consumed in a given period could be compared to the total quantity of fly ash trapped and removed during the same period—perhaps with certain modifications to allow for substantial differences in the quality of refuse handled, such as straight garbage, mixed refuse, or rubbish only. It would be interesting to ascertain, also, at what point the unit quantities so trapped represent a reasonable degree of efficiency.

Design capacity of the furnace grates was conservative at 51 lb per sq ft per hr. Performance tests have demonstrated that, even with the lightweight material being handled, this capacity can easily be exceeded by 40 percent—but not without some slight sacrifice to the balanced conditions existing at, say, 60 lb per sq ft per hr. The plant is therefore capable of handling an average of over 500 tons of rubbish per day and has been doing so consistently. Important design factors contributing to this result have been the relative efficiency of the hydraulic reciprocating grate systems as adapted to the mutual-assistance cell principle, the provision of ample pit capacity (3,100 cu yd) and extra-large charging openings (four per furnace, each 4 ft 6 in. × 4 ft 8 in.). Adequate over-fired air provisions and ample furnace volume (14.1 cu ft per ton) have given excellent temperature control. Dump-grate sections in each cell were increased to 28 in. × 48 in.



Furnace fronts (above), on stoking floor, have hydraulic gage controls. Note instrument panel at left. Each stack rises from an interior court (shown in view above right), which is surrounded on three sides by expansion chamber (to which doors give access). Piping is part of vacuum system for fly-ash removal. Expansion chamber and flue volume exceed that of any other known plant.

The plant is equipped with three cranes, one of which constitutes a spare. It is so designed that parking facilities are available for each crane. This was done by lengthening the building to include parking bays at each end (thereby providing additional pit capacity) and leaving sufficient space between the two center furnaces to serve as a parking area for the center crane. There are two identical machinery rooms on the ash-tunnel level, each serving two furnaces, with independently operated motors, compressors, and pumps. These were provided to keep at least 50 percent of the plant in operation at all times, and certain vital equipment such as hydraulic pumps and compressors are alternating units designed for full plant loading.

Significant design change

A significant design change indicated by past experience as most desirable from the maintenance standpoint was the use of sectionally supported air-cooled walls and suspended arches throughout furnaces and flues. This type of construction also permits a furnace and combustion chamber arrangement which simultaneously provides two worthwhile betterments: (1) it permits changes in direction and more impingement for the large volume of gases; and (2) it satisfies an essential requirement for adequate light and ventilation for the furnace-floor level.

The number of men required to serve the furnaces at this plant total 9 per shift—2 crane operators, 2 hopper men, 4 furnace men, and one man in the ash tunnel. (This does not include those engaged in hauling away 500 cu yd of residue, manning the weighing scale and platform on day shifts only, and foremen and utility men). Unit costs for disposal have been reduced at least one-third to one-half over the costs at the two old plants. Experience with the Mt. Olivet Incinerator has been most gratifying for the simple reason that it is performing so well the task for which it was constructed. It is difficult to comprehend how such light-weight heterogeneous material can be incinerated under present-day wage rates for much less than $2.00 per ton, or 20 cents per cu yd, which is the indicated unit cost. Savings in truck haul and higher standards of sanitation are important factors tending to offset these costs.

The two-fold problem of rapidly expanding communities and constantly increasing per capita production of combustible wastes presents a serious disposal challenge that cannot be bypassed much longer in many areas in this country. The indispensability of properly designed and carefully operated incinerators, located reasonably close to the heart of large centers of population, is becoming progressively more evident. Fringe-area landfills must either be conserved for non-combustibles or the long-distance shipment of huge volumes of raw refuse must inevitably become economically prohibitive. Obviously these axioms of big-city refuse disposal do not apply to the small or even moderately-sized, isolated community where there is greater latitude for alternate methods of disposal.

Design and equipment details of the Mt. Olivet Incinerator are given in Table I.

(This article was originally presented as a paper at the ASCE Annual Convention, before the Sanitary Engineering Division session presided over by Roy J. Morton, Vice Chairman of the Division's Executive Committee, and Paul W. Purdom, A.M. ASCE.)

TABLE I. Design and equipment details for Mt. Olivet Incinerator

Engineering design, Division of Sanitation, and Department of Buildings & Grounds, District of Columbia. Review by Greeley & Hansen, Chicago, Ill.

Prime contractor, J. D. Hedin Construction Co., Washington, D. C.

Construction cost, $1,971,000 (excluding site, planning and engineering, and inspection)

Design details

Furnaces, four:	
Capacity of each, tons	125
Capacity total, tons	500
Grates in each furnace:	
Area, sq ft. (8 ft 6 in. × 24 ft 1 in.)	204
Design capacity, lb per sq ft per hr.	51
Test run No. 1 (24 hr), lb per sq ft per hr	61.4
Test run No. 2 (18 hr), lb per sq ft per hr	71.3
Volume of furnace, cu ft (14.1 per ton)	1,762
Volume of combustion chamber, cu ft (32.5 per ton)	4,062
Volume of flues (expansion chamber included), cu ft (209 per ton)	26,125
Stacks, two	11 ft dia × 165 ft
Dampers	Guillotine, refractory
Method of charging hoppers, 3 cranes (1 spare)	
Overfire air:	
8 intakes, 2 per cell	Size 12 in. × ¾ in.
Auxiliary fuel	None
Length of storage bin, ft	172
Capacity of storage bin (steel lined throughout), cu yd	3,100

Equipment details

Grates, hydraulically powered stokers, Flynn & Emrich Co., Baltimore, Md.

Furnace construction, general, Nichols Engineering & Research Corp., New York, N. Y.

Charging gates and ash gates, Beaumont Birch Co., Philadelphia, Pa.

Radial chimneys, The Rust Engineering Co., Pittsburgh, Pa.

Cranes, 3-ton capacity, Harnischfeger Corp., Milwaukee, Wis.

Crane buckets, 2-cu yd capacity, Blaw Knox Co., Pittsburgh, Pa.

Motor truck scale, direct-reading, dial-type (capacity 62,500 lb), Fairbanks Morse & Co., East Moline, Ill.

Suspended walls and arches, M. H. Detrick Co., New York, N.Y.

Instruments, recording and indicating, Minneapolis Honeywell

Vacuum cleaning system, Spencer Turbine Co., Hartford, Conn.

Freight elevator, Warsaw Elevator Co., Warsaw, N.Y.

Compressors, American Air Compressor Corp., North Bergen, N.J.

SMALL SEWAGE TREATMENT PLANT

remodeled to handle milk and cannery wastes

The City of Seymour, in the northeastern part of Outagamie County, Wisconsin, in the heart of a very rich agricultural and dairying region, felt the full impact of the expansion of the milk products and food processing industries during and after World War II. The increase in industrial waste, due to the expansion of these industries, caused such an overload on the existing sewage treatment plant that its effectiveness was completely destroyed. In the spring of 1952, the city set out to correct this problem.

The city's sewage system and treatment plant were built in 1935–1936 at a cost of $22,276 for a design population of 2,000 plus an additional 500 equivalent to handle a small industrial load. This was made up of wastes from a milk receiving station handling up to 13,000 lb a day and the effluent from a small canning factory which first treated its waste by screening and chemical treatment in draw-and-fill tanks.

The city's treatment plant was a straight activated sludge plant, consisting of a hand-raked bar screen, raw sewage well and pumps, one primary tank, three aeration tanks with downdraft mechanical aeration, one final tank, digester, sludge beds and service building. The plant worked exceedingly well for the first few years of operation, and produced a crystal clear effluent with a B.O.D. reduction of from 90 to 95 percent. During World War II, however, the Badger Consolidated Co-op mushroomed from a small receiving station to a very large-sized milk processing and pasteurizing plant. The Seymour Company also increased its packing operations to the extent that the fill-and-draw tanks gave very little if any treatment to the waste and were finally abandoned entirely. Consequently untreated waste was discharged into the city sewers. As a result of this large increase of industrial waste, the treatment plant could nowhere near carry the load imposed upon it. At no time was there any semblance of activated sludge and during most of the year odors arising from the plant and nearby stream could be characterized as a gross nuisance. The nearby stream was entirely depleted of dissolved oxygen.

Studies point the way

Loadings and sources of wastes were carefully investigated. We found that the Badger Consolidated Co-op was processing an average of over 250,000 lb of milk a day with a peak of over 340,000 lb; 40,000 to 50,000 lb was used daily in making cheese. Altogether about 83,000,000 lb of milk was processed at this plant in 1954.

The Seymour Canning Company canned peas, whole corn, beets, green and string beans, carrots, pork and beans, and sauerkraut—a maximum of about 4,000 cases a day. This company's canning operations extend from about the middle of June to the latter part of December, or over a six-month period approximately. It canned 324,752 cases in 1954. The State Sanitary Department recommended that the Badger Co-op build a trickling filter and holding tank at its plant, and that the Seymour Canning Co. pond its wastes. However, investigation showed that it was not feasible from the standpoint of location, convenience, or cost for either of these plants to provide its own waste treatment. Therefore both plants asked the city to provide treatment of their waste in its sewage treatment plant.

Use of trickling filters for secondary treatment in place of the existing activated sludge units was first considered. However, on the basis of the known loadings, it would require four trickling filters approximately 90 ft in diameter to give the B.O.D. reduction required and to provide a sufficiently stable effluent to be acceptable for discharge into the small, sluggish receiving stream. The trickling-filter method was obviously prohibitive from the cost angle for both the city and the industries.

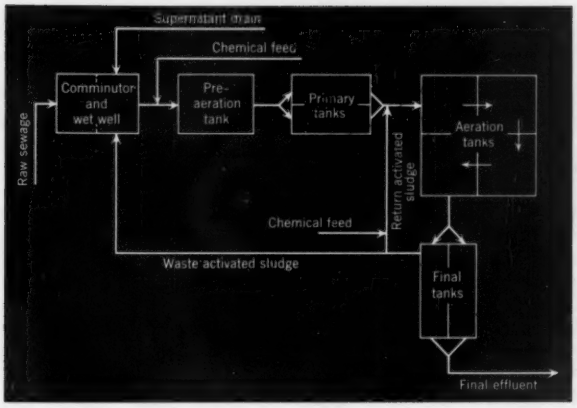
Then the suggestion was made that alum or some other coagulant be added to the return activated sludge as a means of increasing the capacity of the present activated sludge plant. A temporary dry-feed machine was rigged and about 100 lb of alum was added per day to the return activated sludge. The results were found to be very promising. The most immediate result was the complete elimination of odors. An activated sludge never actually formed but a good floc was noted, and a considerable amount of solids, which formerly had gone over the weir of the final tank, were being settled out. However, it was evident that neither the primary nor the final tanks were adequate, nor were the mechanical aerators capable of injecting enough air to produce a dissolved oxygen residual anywhere in the plant.

These studies and experiments were carried on by Walter Muehl, Director of Public Works, Levi Blohm, Plant Operator, and the writer, whose firm, the McMahon Engineering Company, had been called in as engineering consultants. If it had not been for the fine cooperation of the City Council and Mayor Carl Kuehns, it would have been impossible to finance these investigations, which made it possible to arrive at a sound design for the improvements.

Improvements carried out

The plant improvements, designed by the writer's firm, were as follows:

1. A pre-aeration unit, with a downdraft mechanical aerator, was added.
2. The handraked bar screen was replaced by a comminutor.



M. O. CLINTON, President,

McMahon Engineering Co., Menasha, Wis.

FIG. 1. Flow diagram shows arrangement of remodeled sewage treatment plant of Seymour, Wis.

3. The existing final tank was converted into another primary tank.

4. One aeration tank was added to make four in all.

5. The downdraft mechanical aerators in Tanks 1 and 3 were replaced by impingement-type diffused-aeration units made by Walker Process Equipment, Inc.

6. Two final tanks were added.

7. The present service building was enlarged.

The design basis for the plant after all alterations and additions is given in Table I, and the tank sizes in Table II. A flow diagram is given in Fig. 1. A maximum design flow of 500 gpm was used.

Additions to the plant were built by the Eisenreich Construction Co. of Seymour, Wis., while the new aeration equipment was installed by the city crew, in accordance with the plans and specifications and under the supervision of the McMahon Engineering Co. All headers, piping, air lift, etc., were furnished by the Walker Process Equipment Company, Inc., and shop fabricated, which made installation very simple. The motors and compressors were mounted on the old bridges originally required for the mechanical aerators. This permitted the use of existing electric conduit. The improvements were completed and the plant placed in full operation in the middle of June 1953, only two days before the canning season started. Actually the plant should have been put in operation at least a week earlier to give it a chance to operate as an activated sludge plant before the heavy industrial load hit it.

Good operating results

The 1953 season was one of the best in the history of the canning plant, which was in operation an average of 18 hours a day with loadings of 20,000 to 25,000 population equivalent. Even under these conditions, the sewage treatment plant operated very satisfactorily, showing B.O.D. reductions in pea and corn waste of from 95 to 98 percent. The beet waste carried a larger B.O.D. load; however the plant effected a reduction of 90 to 92 percent. This was not sufficient to cause depletion of the dissolved oxygen in the small receiving stream.

Further studies during the 1953 season led to the decision to replace the downdraft mechanical aerators in Tanks 2 and 4 with Walker's impingement-type diffused aerators. Also, one 10-hp motor and compressor were added to increase the air capacity for handling beet waste. Alum was added as a coagulant during the pea, corn, and beet canning season only.

With these changes the results obtained during the 1954 and 1955 canning seasons were most gratifying, as shown by the operating data in Tables III and IV. Table III gives average results for 1954. The operating results for each particular vegetable pack were grouped together and averaged. There were some peak days considerably above this average, reflecting the ups and downs of canning-plant operation. At all times, a water-clear effluent was produced, and during the beet pack we were surprised and gratified to see that the characteristic blood-red color of the beet waste was almost completely removed, the only color remaining in the effluent being a light straw color.

The coagulant—used only during the pea canning, whole-grain-corn canning and red-beet canning seasons—was added both to the raw sewage and to the return activated sludge. Waste activated sludge was discharged to the raw sewage so that it would receive the additional benefit of the coagulant and aeration in the pre-aeration unit. It is possible that good operation can be obtained with less chemical coagulant, although the cost of the coagulant is very nominal. This question will be studied in subsequent canning seasons.

The coagulant (alum) was not added immediately at the start of each of these packs. Instead plant operation was closely observed as soon as canning started, taking note of the dissolved oxygen in the aeration tanks and the condition of the sludge in the final

TABLE I. Design basis for plant after all alterations and additions

Source	Max. Gal per Day	Max. Gal per Min	% of Total	Max. B.O.D. Lb per Day	Popula. Equiv.	% of Total
City	150,000	200	40.5	276	1,650	6.2
Creamery	40,000	66	10.8	794	4,750	17.8
Cannery	180,000	180	48.7	3,390	20,300	76.0
Totals	370,000	446	100.0	4,460	26,700	100.0

TABLE II. Tank sizes in improved plant

Tank	No.	Dimensions	Detention at Max. Flow
Pre-aeration	1	20′ × 20′ × 10′ wide	60 min
Primary	1	18′ × 10′ × 8′ wide	65 min
	1	33′ × 11′ × 9′ wide	
Aeration	4	21′ × 21′ × 14.5′ wide	6 to 7 hr
Final	2	38′ × 9′ × 9′ wide	92 min
Digester	1	1,000 cu ft	...

settling tanks. As the dissolved oxygen approached zero and the sludge in the final tank showed signs of incipient bulking, the coagulant was added. It was amazing to note how fast the plant came around after this was done. In only half a day the dissolved oxygen would come back up and the sludge would settle down to a cohesive blanket 4 or 5 ft below the weir troughs.

The new impingement aeration units did a very good job of air diffusion. Each header was located along the centerline of the tank, so that the contents were stirred in two back-to-back spiral rolls. At no time did the dissolved oxygen in the aeration tanks get below 2 ppm. No maintenance or repairs were required on these units throughout the entire season even though there were several power failures which allowed the diffusers and air-supply riser pipes to backfill with tank liquor.

In the first operating season, we were not sure just what suspended solids concentration ought to be maintained in the mixed liquor. We were therefore obliged to operate somewhat on a cut-and-try system. An effort was made to hold the solids down as much as possible, but any time clarification suffered or a tendency to bulk occurred, the solids were allowed to increase. In reviewing the operating data, we found that we were using somewhere between 3.7 and 4.5 lb of mixed-liquor solids per pound of 24-hr B.O.D. applied. This did not vary with the use of the coagulant in the return activated sludge.

Disposal of sludge is still an undecided problem. The digester is obviously undersized. During the season of heavy load the digester was used merely for sludge storage, and sludge was hauled away periodically in a tank truck and disposed of by spreading on agricultural land. This may be the permanent method of disposal because farmers in the vicinity have welcomed the sludge for fertilizer, and the cost of tank trucking has not been particularly high. At present we are investigating the possibility of dewatering the sludge, and disposing of it in an incinerator together with municipal garbage and refuse. However, this is not a pressing problem and no immediate changes are contemplated.

A few cost figures will be of interest:

Original plant cost	$22,276
Additions, approximately	50,000
Total cost	$72,276

There is a total connected horsepower, including pumps, blowers and sludge collectors, of 45. Of this, the blowers represent 27½ hp and the pre-aeration unit 7½ hp. During the canning season, all the blowers are operated, and the mechanical aerator on the pre-aeration unit is run continually. When the cannery is not in operation, from the end of the canning season to about the middle of June, only one 10-hp blower is needed, and the pre-aeration unit, which is controlled by a time switch, is operated about 40 percent of the time.

During the 1954 season, the Badger Consolidated Co-op processed approximately 83,000,000 lb of milk intake; and the Seymour Canning Company canned the following cases (24 one-pound cans per case):

Peas	94,708
Corn	36,355
Beets	27,060
Carrots	12,143
Pork and beans	39,048
Sauerkraut	51,684
Beans (green and string)	63,754
Total	324,752

The cost of alum coagulant for the year 1954 was $1,204, and the power cost, for a total of 215,327 kwhr, was $4,036.50, an average of $0.019 per kwhr. Of this, the 6-month canning season accounted for about 70 percent.

Conditions in the 1955 season were similar. In that year 46,500 lb of alum were used at a cost of $1,372. Operating results are given in Table IV, based on analysis of composite samples.

The plant is operated by one full-time operator with assistance from the city labor pool as required.

It has been particularly gratifying to the city officials to have the farmers call on them and tell them how pleased they are that the pollution in the stream has been stopped.

The pre-aeration unit has proved to be a very economical and valuable addition to an overloaded plant. It greatly increases B.O.D. removal in the primary tank and serves as an excellent flocculation unit when chemical treatment is used.

TABLE III. Summary of 1954 plant performance

Loading	Av. Daily Flow, Gal	B. O. D. in ppm: Raw Sew.	Prim. Effl.	Reduction, %	Final Effl.	Reduction, %	Dis. Oxygen Fin. Effl. ppm	Coag. Used, lb/day
Before canning season*	150,000	625	188	70	15	97.6	2.0	0
During canning of:								
Peas	300,000	752	303	60	20	97.3	2.5	800
Corn†	300,000	723	236	67.5	7	99	2.1	800
Green beans	300,000	340	175	48.5	13	90.3	3.2	0
Red beets‡	250,000	695	220	68.3	20	97	2.1	625
Carrots	175,000	705	355	49.3	18	96.1	3.5	0

* Peak milk-waste load. † Whole grain. ‡ Includes some sauerkraut.

TABLE IV. Analysis of composite sewage samples taken at plant, season of 1955–1956

Date Taken	B. O. D. in ppm: Raw Sew.	Prim. Effl.	% Reduction	Final Effl.	% Reduction	Settl. Sol. Mixed Liq. 30-min Settling, ppm	Act. Sludge Gal	Waste %	Type of Canning
1955									
2/7	460	300	35	9	98	240	100	..	...
2/18	510	280	45	11	98	240	100	..	...
3/16	610	370	39	20	97	400	100	10	...
5/4	240	86	65	9	96	260	100	..	...
5/13	360	128	64	8	98	340	100	25	...
6/1	730	295	59	11	98	310	125	10	Pork & beans
6/2	810	440	46	19	98	320	125	10	Pork & beans
6/3	840	510	39	24	97	380	125	..	Pork & beans
6/15	490	240	51	11	98	430	100	..	...
6/21	420	240	43	10	98	490	125	25	...
6/30	780	420	46	37	95	260	125	25	Peas, power off day before
7/1	620	440	29	47	92	250	125	25	...
7/6	690	350	49	25	96	380	125	25	Peas
7/7	860	357	58	24	97	420	125	25	Peas
7/11	1060	877	17	22.5	98	270	125	25	Peas*
7/27	520	300	42	12	98	190	130	20	...
8/19	980	510	48	12	99	170	120	10	Beans, corn
8/24	1080	420	61	13	99	220	120	20	Beans, corn
8/29	1120	600	46	14	99	190	130	10	Beans, corn
9/1	1220	480	61	23	98	250	130	10	...
9/28	1140	740	35	33	97	160	100	10	Beets*
10/3	1220	700	42	18	99	200	100	10	Beets*
10/19	1470	780	47	31	97	340	100	20	Beets*
11/10	1700	950	43	36	98	280	100	..	Carrots
11/22	740	510	31	22	97	150	100	..	Kraut†
1956									
1/5	380	150	60	9	98	300	100	10	...
1/19	285	177	38	5	98	370	100	..	...

* Samples by Wisconsin State Board of Health. † Two compressors, 17½ hp.

In recirculation tests, a system of plastic pipe and a control system of galvanized steel pipe were used. Disinfection tests indicated that plastic systems, after seeding with *E. coli*, could be satisfactorily disinfected by standard procedures. High chlorine concentrations caused no damage.

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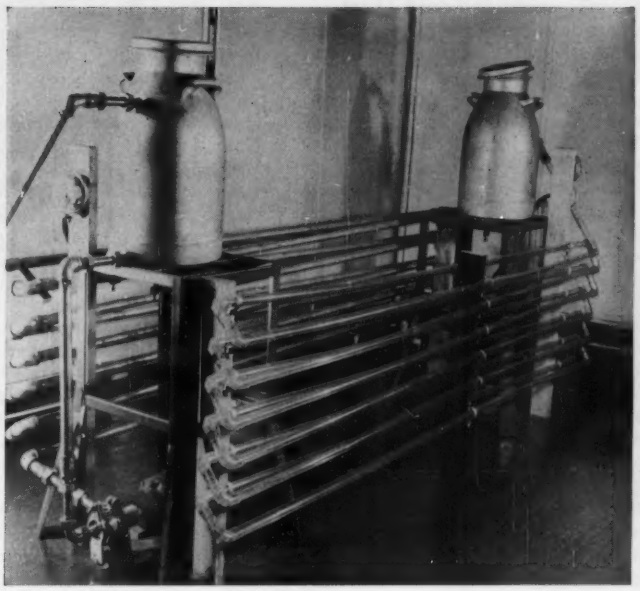


PLASTIC PIPE

found suitable for potable cold water supply

During the past three or four years an extensive study has been carried out to determine the suitability of plastic pipe for the underground transmission of cold water for drinking water supplies. This study was made at the School of Public Health, University of Michigan, by the National Sanitation Foundation, a non-profit corporation supported by contributions largely from industry. However, it is managed by a board of trustees consisting of influential men from many walks of life who have no personal interest at stake. Its purpose is to carry on much-needed research in sanitation and to promote uniform standards in that field. Through the courtesy of the Board of Regents of the University of Michigan, the Foundation is housed at its School of Public Health. The study of plastic pipe was financed to a large extent by grants from the Society of the Plastics Industry.

This study was designed to answer the fundamental question as to whether, from the standpoint of maintaining the quality of the water and adequately protecting the public health, designing engineers should consider the use of plastic pipe in potable water supplies. Some have declined to use it either on their own initiative or on the advice of state regulatory officials, largely for want of this basic information.

Sooner or later the question comes up, "What is meant by plastic?" Defined broadly it could include many things. Webster's *New Collegiate Dictionary* defines it as "any of a large group of organic, synthetic, or processed materials that are molded or cast. . . Some are cellulose derivatives, some proteins, and many are resins formed by chemical condensation or polymerization. Rubber and similar materials (as neoprene) are sometimes included among plastics. Plastics are commonly known by their trademark names." A plastic may have only a few simple ingredients or may contain in addition to a resin or cellulose derivative, one or more of such things as coloring material, mold lubricant, plasticizer, antioxidant, accelerator, stabilizer, and filler. There is such a wide variety of products that it is practically impossible to speak in general terms of plastic pipe. Recognizing this, the manufacturers have wisely undertaken a program for placing an easily recognized hallmark on pipe tested and found satisfactory for potable water supply use.

The study included 3 samples of polyethylene pipe, 8 of pipe classified as rubber-modified polystyrene, 5 of polyvinyl chloride pipe including Saran (a polyvinyl-vinylidene), 3 of cellulose acetate butyrate—all recommended for water supply use. In addition, for comparison, there were 3 special samples not recommended for water supply use, one of polyethylene electrical insulation material, and two of polyvinylchloride, one containing a complex lead compound and the other cadmium and barium salts. This made the total of 22 samples tested. Incidentally, the report contains an appendix which gives simple methods for differentiating these general groups of plastics by flame test and by specific gravity. For instance, polyethylene pipe floats in fresh water.

Tests were performed to determine possible reactions between plastic pipe and its use environment—particularly air, water, and soil. Similar sections of galvanized steel and copper pipe were used as controls.

Early in this work a search was made for an aggressive natural water. This search showed that Ann Arbor water, which is treated and chlorinated, is as aggressive as any of the natural waters of a group selected for such qualities as low or high pH, high chlorides, high

naturally occurring fluoride, hardness, high mineral content, high sulfates, and high carbonates. It was found that Ann Arbor water could be made more aggressive in the extraction of heavy metals from plastic by lowering the pH through the introduction of carbon dioxide gas. A pH of 5.0 was used because it was felt that water of lower pH would not be used for a potable supply without adjustment. This water was used throughout the work for the water contact and extraction tests.

To test the air contact, prepared sections of the samples of plastic pipe were exposed to natural weathering for a period of one year under standardized conditions. There were slight changes in color in a number of instances, and a fine surface film formed on the samples of rubber-modified polystyrene.

Specimens of all the test plastics were buried in an acid soil of pH 2.0 and held at 35 deg C for one year, with intermittent wetting and drying using distilled water to simulate rainfall. Very little effect could be observed on any of the test plastics. The soil was obtained from the grounds of a chemical plant at which an underground line of galvanized steel pipe had been attacked by the soil to the point of developing leaks within a year after it was laid. Some discoloration of samples was noted and also a tendency to form a thin film at the soil-plastic interface. By comparison, the section of copper pipe similarly buried showed considerable oxidation and deposition of film, while the galvanized steel specimen showed pronounced deposits at the soil-metal interface.

Specimens of plastic pipe held partially immersed in the test water in sealed large-capacity glass stoppered bottles for one year at 35 deg C, showed slight color changes, slight film formation and, in some instances, a slight fungus growth. In comparison, the copper tubing under identical conditions showed a fine black sediment and the specimen of galvanized steel pipe was covered with a heavy white floc.

Well controlled experiments indicate that plastic pipe in all four classifications is susceptible to the attack of rodents when it obstructs their access to food. This was most pronounced with a polyethylene, probably because of the softer nature of this formulation. Plastic pipe was attacked by both *Rattus norvegicus* and *Rattus rattus*. There was no evidence that the rats ate the plastic or that they gnawed it in preference to other substances.

A procedure was developed for subjecting cut specimens of plastic pipe to extraction by aggressive water. Results showed that it was impossible to extract any deleterious substances from any of the samples tested which were recommended by the manufacturers for domestic water supply use. This was true even though the pH of the water used was lowered artificially to about 5.0 to make it more aggressive. Natural waters do have pH values as low as 5.0.

To demonstrate that the water used was aggressive enough to extract some substances from plastic pipe, special samples were prepared, one a polyethylene electrical insulation compound (No. 130) and another a polyvinyl chloride compound (No. 280) containing lead and cadmium. Enough color was extracted from the sample containing electrical insulation compound to increase the color of the test water from 0 to 35 (orange-brown). From the polyvinyl chloride sample containing lead, 0.34 milligram of lead per liter were extracted using the test water at its natural pH of 9.6, and 1.25 milligrams per liter were extracted when the pH was lowered to 5.0. It should be noted, however, that less than 6 percent as much lead was extracted from the polyvinyl chloride pipe with water of pH 9.6 than from lead pipe under similar conditions.

As further evidence of the aggressiveness of the test water, special samples were prepared containing varying quantities of lead, cadmium, and barium of much greater magnitude than was likely to be used in making plastic. The standard aggressive water, following the standardized procedure, extracted 2.40 ppm of lead from one specimen and 3.90 ppm from a specimen containing twice as much lead. Similarly 0.15 ppm of cadmium were extracted from one special specimen containing cadmium and barium, and 0.30 ppm from a sample containing twice as much cadmium. No barium detectable by the test method was extracted.

Routine chemical examinations of water, after exposure to various plastics, showed no significant changes when compared with similar examinations made on unexposed test water.

Thorough taste and odor tests

In the taste and odor studies, samples of water that had been in contact with cut plastic pipe for 3 days at 35 deg C, with occasional agitation, were submitted for examination to a five-member panel selected for acuteness in differentiating odors and tastes. As controls, samples of the unexposed test water, of water exposed to copper pipe, and of odor-free water were added to those to be examined. All were simply numbered at random and were submitted to the panel as unknowns.

The results showed no greater intensities of odors, as determined by the standard threshold odor test, in any of the samples exposed to plastic pipe than in the controls. Panel members described the odor and also the taste, although it is recognized that odor necessarily influences taste. The characteristics of the odors and tastes appeared to be about the same for the standard water and copper-exposed controls as for the waters exposed to plastic pipes. There was a tendency to describe the odors and tastes as chemical or medicinal, which may be due, to some extent, to the fact that the test water was chlorinated.

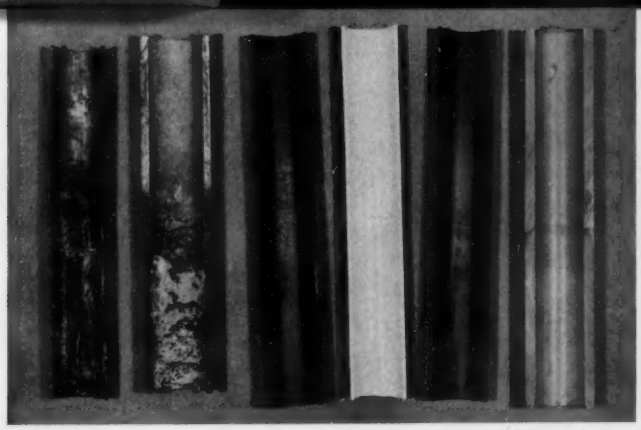
It should be remembered that exposure conditions were purposely severe in these tests and probably will not be duplicated under actual use conditions.

Additional odor and taste tests were run on samples of test water that had been recirculated in systems of plastic pipe. This was done in order to introduce the possible effects of fittings and of compounds used in joining the pipe and fittings, and to simulate a water supply system. Two differences which increased the severity of the test were that the water was at room temperature and was recirculated, being alternately pumped for 30 min and allowed to stand quiescent for 30 min throughout the 3- to 7-day period of exposure. None of the samples tested gave threshold odors greater than the controls, or abnormal odors or tastes, with one exception.

In this instance, on first trial, the highly volatile solvent or the cement used for making joints in the cellulose acetate butyrate system, following manufacturer's instructions, gave a pronounced undesirable odor and taste to the recirculated water. The threshold number was 150. However, after the system was emptied and air run through for several hours, followed by flushing with water, a repetition of the test gave odors and tastes similar to the controls. Nevertheless, the empty system, after standing several days, gave off the characteristic odor of the solvent. It is understood that the manufacturer is changing the solvent.

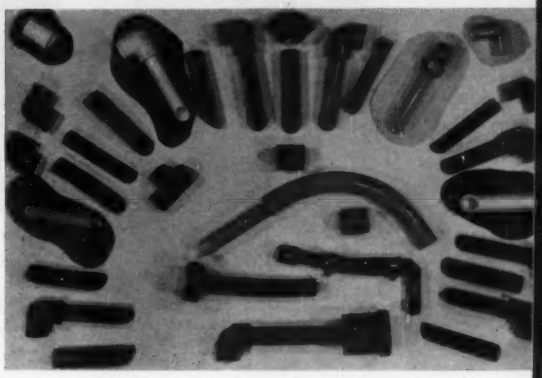
In tests to determine the effect, if any, of plastic pipe on chlorine residuals in water, it was found that in no instance was the reduction in free chlorine residual so rapid as to materially change the effectiveness of the chlorination of tap water.

Recirculating systems of each of the four general types of plastic pipe under study were heavily seeded with cultures of *E. Coli*. After prolonged exposure this was drawn off and the system subjected to disinfection using approximately 200, 50, and 25 ppm of hypochlorite respectively. After 15-hour to



Lower halves of various pipe sections, after burial for one year in acid soil, appeared as shown here. Left to right: Copper, galvanized steel, and the four plastics showing most pronounced effects. Very little effect could be observed on any of the plastics tested. Copper pipe showed considerable oxidation and film deposition, and galvanized steel had pronounced deposits at soil-metal interface.

In all, 22 types of plastic pipe and fittings were tested. These included all types in common use for conveying drinking water plus a few experimental samples. It was concluded that plastic pipe of types recommended for use in potable water systems is satisfactory and does not make water toxic, unsightly, or unpalatable.



24-hour contact with the circulated chlorine solution, it was discarded, the system flushed with fresh tap water, rinsed with dechlorinated water, and the rinse water examined for the presence of *E. coli*. Although small residuals of *E. coli* were recovered following treatment, in some of the test procedures, these numbers were so small as to come within the criterion of chemical disinfection ordinarily considered to be satisfactory. The results indicate that such systems can be satisfactorily disinfected following standard disinfection procedures.

In experiments using high concentrations of chlorine on the various plastic classifications, no adverse effects were noted on the plastics after 20-hour exposure at 10 deg C. Adverse effects on copper and galvanized-steel specimens were noted, however, when these were held under similar conditions. Higher than usual concentrations of chlorine may be used in the disinfection of plastic pipe without damage.

Feeding experiments

Studies were made of Wistar-strain rats which drank, exclusively for 18 months, water that had been held in contact with various groupings of plastic pipe. This included a group containing substances such as lead and cadmium which had been found to be extractable with the test water. Also, a control group of rats was observed, which drank exclusively the test water without contact with plastic, and another group, which drank only the test water after contact with copper pipe. Observations and tests, of rats dying or sacrificed before the expiration of 18 months, as well as of the 36 sacrificed at the end of that period, showed no appreciable abnormal effects as compared to the control group. Growth, food consumption, and water consumption were similar in all the groups. The results of autopsies, as appraised by an expert, Dr. Carey P. McCord, showed no evidence of any damaging action finally attributable to the test plastics.

The groups of rats fed on water in contact with special specimens of plastic pipe containing lead, cadmium, and barium, did not show excessive amounts of lead in the blood at the end of the feeding period.

Practical application of results

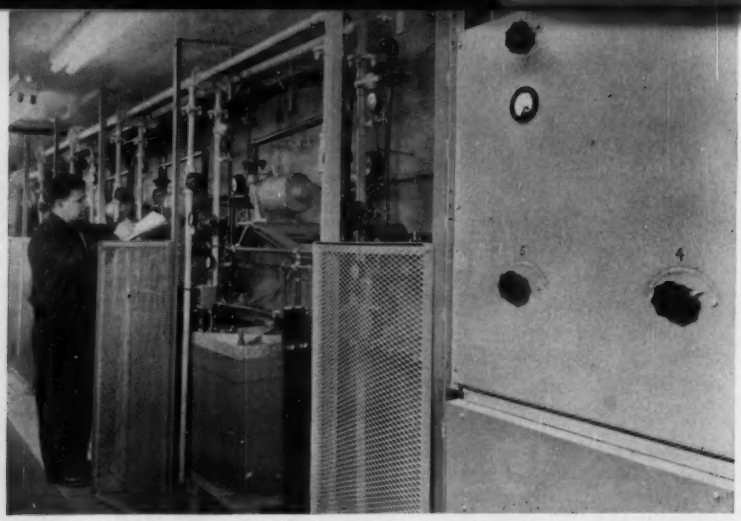
The reported favorable results apply to the particular formulations of plastics tested. It remains to identify these formulations so that the man in the field can recognize them on the job, and to provide for the testing and similar identification of new formulations. A plan has been developed calling for the testing, regular retesting, and listing of plastic materials satisfactory for potable water supply use, with certification to pipe extruders of such materials. The plan also calls for the marking of approved plastic pipe at intervals of not more than 18 in. with the National Sanitation Foundation's seal, consisting of the letters "nSf," and optionally the addition of the words "Drinking Water." Authority to use this seal is based on a preliminary inspection of the extrusion plant, with reinspection as often as required but at least annually, and also the retesting of samples of extruded pipe as required, but at least annually. The right to use the seal of approval may be withdrawn at any time for failure to maintain required standards.

This study has shown that plastic pipe of certain types, including those commonly recommended by manufacturers for water supply use, when properly installed, does not introduce toxic substances, affect color, flavor, or odor of the water, and does not interfere with maintaining chlorine residuals, or in disinfection of new pipelines. A plan has been developed and is now in effect for placing a controlled hallmark on plastic pipe which on test has been found suitable for use with potable water supplies, thus giving the engineer a practical basis for identifying and specifying plastic pipe suitable for this use.

For the study here reported, much credit is due an advisory committee of experts representing public health and industry. The members were sanitary engineers R. J. Faust, M. ASCE, C. W. Klassen, O. J. Muegge, B. A. Poole, M. ASCE, and J. H. Svore; Dr. R. A. Saxvik; and representing industry, E. M. Adams, P. S. Britton, W. E. Jacobson, W. E. McCormick, and J. S. Whitaker. This committee gave much advice, reviewed progress reports during the course of the study, and served as an editorial committee for the final report. (This report is available at $1.00 per copy from the National Sanitation Foundation, School of Public Health, University of Michigan, Ann Arbor.)

Other criteria must be used to select pipe for its physical characteristics. This question is being answered in a separate study in another laboratory, also sponsored by the Society of the Plastics Industry.

(This article was originally presented by Mr. Tiedeman as a paper at the ASCE Dallas Convention, before the first session on plastics to be sponsored by a Technical Division of the Society. This session of the Engineering Mechanics Division was presided over by Albert G. H. Dietz, chairman of the Division's Plastics Committee.)



Most recent development in demineralization of saline waters is electrodialytic process, which utilizes the properties of semipermeable selective ion membranes. Experimental unit for treating sea water, under test by U.S. Navy, is seen at left. Above is multistage installation which provides 30,000 gal per day of drinking water from brackish water for Bahrein, on the Persian Gulf. Maker of both units is Ionics, Inc., Cambridge, Mass.

Cost estimates favor ELECTRODIALYSIS for

In recent years much interest has been centered on the research and development program to recover usable water from saline water. This interest has been largely promoted by the U.S. Department of Interior's Saline Water Conversion Program, which started in 1952. At the outset it was realized that the success of any technique or apparatus for this purpose must be judged entirely on the basis of cost. A recent report clearly illustrates this point:

"At the beginning of the Saline Water Conversion Program, the cost of converting sea water was estimated at about $400 to $500 an acre-ft. Accordingly, two arbitrary criteria were set for the initial 5-year phase of the program, one for water for municipal and similar purposes and one for irrigation water. For these criteria no distinction is made as to whether the water to be converted is sea or brackish water. These goals were $125 and $40 per acre-ft (38 and 12 cents per 1,000 gal) respectively and they were believed, on the basis of data then available, to represent about the maximum that could be borne by these types of use."[1]

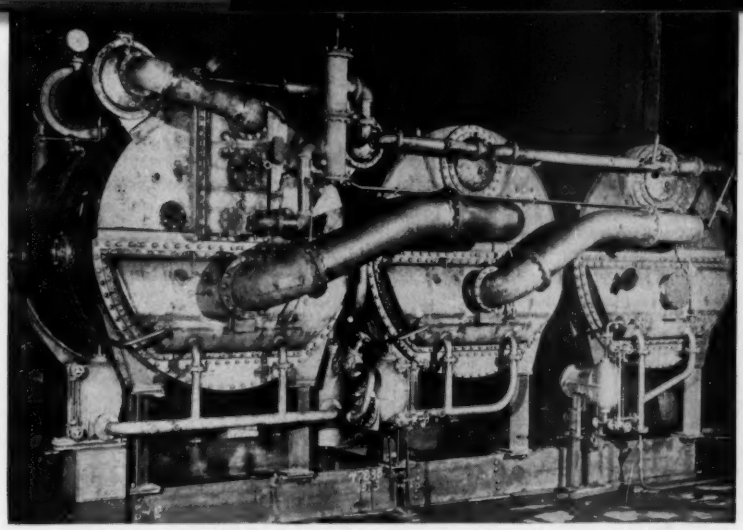
Several publications[1, 2, 3, 4] present descriptions of methods for reclaiming fresh water from saline water, together with the theories involved. Each method can be classified as: (1) a proven method (that is, one for which long-time operating data on a successful plant-scale installation are in existence) and for which standard equipment is available; (2) an unproven method, for which standard equipment is available; or (3) an unproven method, for which standard equipment is not available. The first group includes various types of distillation processes, and the second, the direct ion exchange and the electrodialytic methods. The last group consists of demineralizing techniques such as solar evaporation, freezing, reverse-osmosis, and high-temperature and pressure distillation. None of the last group, however, is sufficiently developed to permit a cost comparison with other methods.

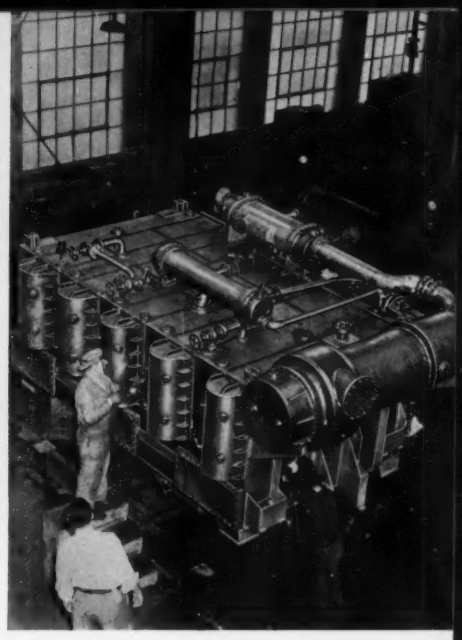
The current status of attempts to recover usable water from saline water can best be presented by comparing the unit treatment costs of each method when applied to a saline water of given characteristics.

Let it be assumed that 2 mgd of treated water is to be furnished from a deep-well supply producing raw water of the quality indicated in Table I. In general, the objectionable qualities of this water are defined by a high dissolved solids content, a high chloride content, and a high total hardness content. In addition, aeration and stabilization are needed to produce a nonaggressive stable effluent free from objectionable tastes and odors. If the quality criteria of the treated water are to conform to the 1946 Drinking Water Standards of the U.S. Public Health Service, reduction of the chloride and total dissolved solids concentrations is needed, as shown in Table II. Also, the 581-ppm total hardness should be reduced to the upper limit of 100 ppm normally accepted for municipal water supplies. Successful treatment of the raw well water to meet these standards would produce effluent water generally satisfactory for municipal consumption.

In evaluating the various processes or methods for meeting these criteria, it is necessary to estimate capital outlay, operational costs, and total overall costs of each method based on a unit quantity of finished water. The estimates given here represent costs per 1,000 gal of finished water. Table III lists the unit prices of chemicals, labor, and power that were used in the various estimates. Equipment costs used were manufacturers' quotations plus an estimate of delivery, erection, and housing costs. Operational costs include an estimate for renewals and repairs required to maintain the initial equipment in operating condition for an indefinite period. Total capital costs are based on a 3-percent interest charge and a 25-year amortization period, which results in a gross annual charge of 5.74 percent of the capital outlay.

Although the necessary costs for





At present most fresh water recovered from saline water is produced by one of the evaporation processes. These plants can each provide 50,000 gpd of high-purity distillate from sea water. Both, by Griscom-Russel Co., are designed for continuous automatic operation at low temperature. Plant above, utilizing multiple-effect evaporation, is of three-effect submerged type. Flash-type distillation plant, at right, is five-stage.

treatment of saline waters

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effluent stabilization and for taste and odor control are included in the cost estimates, it has been assumed that standard aeration and chlorination procedures will reduce the hydrogen sulfide concentration to a non-objectionable level and that effluent stabilization is accomplished by the addition of silicate, lime, soda ash, or flue gas as the situation demands. Primary considerations are thus resolved to means of reducing the chlorides, total solids, and total hardness concentrations.

Multiple-effect evaporation. The process of vaporization applied to demineralization methods consists of evaporating a part of the saline water, after which the vapor is condensed to produce fresh water. In multiple-effect evaporation, the vapor from one stage is condensed in heat-exchange units of the next stage, where steam is being produced from brine at a temperature and pressure less than those of the previous stage. Several stages may be used, but three seems to be the normal limit. This method has been in commercial use for years, and at present almost all fresh water recovered from saline water is produced by one of the evaporation methods.

To produce a finished water of not more than 250 ppm chlorides from the raw water of Table I, it would be necessary to produce a distillate at the rate of 1.24 mgd. When mixed with 0.76 mgd of water that has bypassed the evaporators, the effluent water would satisfy the criteria for chlorides and total-solids concentrations but would contain 221 ppm of total hardness. The bypassed water would therefore require partial softening to reduce the hardness constituents of the final product to 100 ppm. For this purpose, sodium zeolite softeners are satisfactory and have been used in determining the costs involved. Table IV presents an estimation of the overall costs for producing 1,000 gal of final effluent by a multiple-effect evaporation plant designed and operated at a 2-mgd rate. The estimated overall cost is $2.45 per 1,000 gal.

Vapor-compression distillation. The evaporation principle is utilized with greater efficiency in the vapor-com-

TABLE I. Characteristics of a raw water from deep-well sources

Constituent	Aver. Concentration
Total dissolved solids, ppm	1617
Silica, ppm as SiO_2	14.3
Iron, ppm as Fe	0.14
Manganese, ppm as Mn	0
Calcium, ppm as Ca	128
Magnesium, ppm as Mg	64
Sodium and potassium, ppm as Na	287*
Bicarbonate, ppm as HCO_3	150
Carbonate, ppm as CO_3	0
Sulfate, ppm as SO_4	169
Chloride, ppm as Cl	643
Fluoride, ppm as F	0.32
Nitrate, ppm as NO_3	0.52
Carbonate hardness, ppm as $CaCO_3$	123
Non-carbonate hardness, ppm as $CaCO_3$	458
Total hardness, ppm as $CaCO_3$	581
Carbon dioxide, ppm as CO_2	25
pH	7.4
Color (cobalt scale)	13
Total alkalinity, ppm as $CaCO_3$	123
Hydrogen sulfide	Appreciable
Temperature	23°C

* Adjusted

TABLE II. Raw water constituents compared with 1946 USPHS Drinking Water Standards

Constituent	Raw Water	Upper Limits
Chloride	643 ppm	250 ppm
Total solids	1,617 ppm	500 ppm*
Taste and odor	Objectionable	Not objectionable

* 1,000 ppm may be permitted

TABLE III. Factors used in estimating unit costs

Item	Cost
Labor, per man-hour	$2.25
Fuel oil, per gal	0.075
Electricity, per kwhr	0.015
Chemicals, per lb:	
Caustic soda, 50% NaOH (liquid)	0.0357
Sulfuric acid, 66° Be	0.0167
Soda ash	0.0215
Alum (filter alum, AWWA Spec.)	0.0283
Sodium silicate	0.0205
Lime, slaked, bagged	0.0150
Rock salt	0.0085

TABLE IV. Cost estimates for multiple-effect evaporation process

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Evaporators and boiler plant (1.24 mgd)	2,500,000
Pumps, piping, chlorinators	70,000
Salt storage, transfer pumps, housing	40,000
Zeolite softeners	80,000
Brine disposal	10,000
Soft-water storage	10,000
Estimated capital outlay	$2,785,000

Overall costs per 1,000 gal of finished water

Fuel	$2.00
Labor	0.09
Maintenance of equipment	0.09
Salt	0.03
Stabilization of effluent	0.02
Capital charges	0.22
Estimated overall costs	$2.45

TABLE V. Cost estimates for vapor-compression distillation process

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Vapor-compression distillation units (1.24 mgd)	3,000,000
Pumps, piping, chlorinators	70,000
Salt storage, transfer pumps, housing	40,000
Zeolite softeners	80,000
Brine disposal	10,000
Soft-water storage	10,000
Estimated capital outlay	$3,285,000

Overall costs per 1,000 gal of finished water

Fuel	$0.21
Labor	0.09
Maintenance of equipment	0.21
Power	0.02
Salt	0.03
Stabilization of effluent	0.02
Capital charges	0.26
Estimated overall costs	$0.84

TABLE VI. Cost estimates for flash-type distillation process

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Flash-type boiler units (1.24 mgd)	2,120,000
Pumps, piping, chlorinators	70,000
Salt storage, transfer pumps, housing	40,000
Zeolite softeners	80,000
Brine disposal	10,000
Soft-water storage	10,000
Estimated capital outlay	$2,405,000

Overall costs per 1,000 gal of finished water

Fuel	$0.83
Labor	0.09
Maintenance of equipment	0.09
Power	0.12
Salt	0.03
Stabilization of effluent	0.02
Capital charges	0.19
Estimated overall costs	$1.37

pression distillation process. This process operates on the heat-pump principle, in which the latent heat of vaporization is continuously reused. The unit first vaporizes water from saline water at atmospheric pressure, after which the vapor is compressed to raise its pressure and temperature and returned to the heating side of the evaporator tubes where it condenses. In this process substantially all the latent heat of vaporization is transferred back to the boiling brine. The fresh water condensate is then withdrawn.

In estimating the costs of treating the raw water by vapor-compression distillation units, the amount of distillate production as well as that bypassed and softened would be the same as in the multiple-effect evaporation process. Table V gives the estimated cost data for treating the raw water to meet the indicated standards of dissolved solids, chlorides, and hardness content. If diesel-driven compressors are used to compress the water vapor, and sodium zeolite units to soften the bypassed water, the estimated overall cost of producing 1,000 gal of finished water is $0.84.

Flash-type distillation. A third process utilizing the vaporization principle is known as flash-type distillation. In this process saline water at a given temperature and pressure is released into a chamber of lower pressure where the water vaporizes. The vapor is then condensed in cooling chambers by the incoming raw saline water, and by this condensation the fresh water is produced.

Finished water containing 250 ppm of chlorides and 100 ppm of total hardness could be produced from the raw water by flash evaporation equipment capable of furnishing 1.24 mgd of distilled water and by partial sodium zeolite softening of 0.76 mgd of the bypassed raw water. Table VI gives an itemized list of the estimated overall costs, which amount to $1.37 per 1,000 gal of finished water.

Ion exchange. Although the cation exchange principle has long been used in conventional water softening plants, recent developments of hydrogen cation exchangers and anion exchangers have made complete removal of dissolved salts by ion exchange a practicable method. The requirements for rinse and regeneration limit ion exchange to waters of less than about 2,500 ppm of dissolved salts,[5] but since the water selected for the present analysis contains only 1,617 ppm, ion exchange may be considered here as a feasible treatment method.

A finished water containing 250 ppm of chlorides and about 630 ppm of dissolved solids can be obtained from the raw water described in Table I by demineralizing 1.24 mgd in ion-exchange units and mixing the treated water with 0.76 mgd of bypassed raw water. The total hardness of the finished water could be reduced to 100 ppm by sodium zeolite softening of 56 percent of the bypassed water, thus producing a finished water meeting the desirable criteria. Table VII lists the estimated overall costs, which amount to $0.87 per 1,000 gal of finished water.

Electrodialysis. The most recent development is the electrodialysis process utilizing the properties of semipermeable selective ion membranes.[6] In operation the process removes equivalent amounts of anions and cations from water almost without regard to the ionic constituents present. It is known, however, that ferrous, calcium, and magnesium cations tend to precipitate on the membranes, thus shortening their useful life and increasing operational and maintenance costs. The water of the present example contains 192 ppm of calcium and magnesium, a concentration greater than is considered safe to apply to the membranes. Pretreatment methods to reduce the calcium and magnesium ions to minimum feasible concentrations are therefore desirable. The overall production costs will be increased accordingly, but the membrane operating life, a major factor in determining the overall costs, can then be estimated at three years.

It has also been determined that the optimum demineralization rate in the electrodialytic units is 40 percent of the feedwater ionic concentration per treatment stage, and the optimum wastage rate is 20 percent of the product water, regardless of the number of stages employed. For the example at hand, a two-stage treatment plant would be required to remove 64 percent (40 percent of the original concentration plus 40 percent times 60 percent of the remaining concentration) of the original chlorides, or to produce a finished water containing 232 ppm of chlorides. In

TABLE VII. Cost estimates for ion exchange process

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Cation and anion demineralization units	330,000
Acid and caustic storage and transfer piping	70,000
Pumps, piping, chlorinators	80,000
Salt storage, transfer pumps, housing	40,000
Zeolite softeners	80,000
Brine disposal	10,000
Soft-water storage	10,000
Estimated capital outlay	$695,000

Overall costs per 1,000 gal of finished water

Sulfuric acid	$0.44
Caustic soda	0.30
Labor	0.02
Maintenance of equipment	0.02
Salt	0.02
Stabilization of effluent	0.02
Capital charges	0.05
Estimated overall costs	$0.87

TABLE VIII. Cost estimates for electrodialytic process preceded by sodium zeolite softening

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Electrodialytic units	720,000
Pumps, piping, chlorinators, housing, drain line, controls	119,000
Salt storage, transfer pumps, housing	90,000
Zeolite softeners	398,000
Brine disposal	20,000
Treated-water storage	50,000
Estimated capital outlay	$1,472,000

Overall costs per 1,000 gal of finished water

Salt	$0.15
Labor	0.06
Maintenance of equipment	0.05
Power	0.12
Membrane replacement	0.14
Stabilization of effluent	0.01
Capital charges	0.12
Estimated overall costs	$0.65

TABLE IX. Cost estimates for electrodialytic process with acid pretreatment alone

Facilities	Estim. Cost
Pumphouse and laboratory	$ 40,000
Reservoir and piping	20,000
Degasifier	15,000
Electrodialytic units	720,000
Pumps, piping, chlorinators, housing, drain line and controls	119,000
Acid storage and handling	20,000
Brine disposal	20,000
Treated-water storage	50,000
Estimated capital outlay	$1,004,000

Overall costs per 1,000 gal of finished water

Labor	$0.06
Maintenance of equipment	0.04
Power	0.12
Membrane replacement	0.14
Sulfuric acid	0.02
Stabilization of effluent	0.02
Capital charges	0.08
Estimated overall costs	$0.48

producing 2 mgd of finished water, the wastage rate would be 0.50 mgd, requiring a feedwater rate of 2.50 mgd.

There are at least two pretreatment processes that can be considered for reducing the feedwater calcium and magnesium content—sodium zeolite and lime-soda ash softening. The latter would reduce the hardness content to about 40 ppm and would not alter the total dissolved solids content significantly, while sodium zeolite pretreatment would reduce the hardness constituents to about zero and would increase the total dissolved solids about 5 percent. Cost estimates show that the overall costs per unit of finished water are approximately the same for both methods, so the sodium zeolite process has been selected for the example at hand because it accomplishes greater hardness removal.

A finished water containing 232 ppm of chlorides and 507 ppm of dissolved salts (as sodium chloride) may be obtained from the raw water described in Table I by producing 2.50 mgd of sodium-zeolite softened water and by passing the entire flow through two stages of the electrodialytic units. The finished water would be rather soft but would meet the quality criteria established earlier in this article. Total overall costs are estimated at $0.65 per 1,000 gal of finished water as shown in Table VIII. The costs are based on salt-regenerated zeolite beds, but a reduction in this unit-cost figure can be realized if a source of sea water or brine is available for regenerating the zeolite units.

There are some experimental data on the use of acid pretreatment of the feedwater to render presoftening unnecessary[7]. The initial results are promising, and if this technique is successful on a long-time basis the estimated overall costs per 1,000 gal of finished water may be reduced materially by eliminating the construction, maintenance and operational costs of the sodium zeolite softening units. It would be necessary, however, to include cost estimates for the acid pretreatment and the subsequent additional pH adjustment of the effluent water, as shown in Table IX. The estimated total overall costs are $0.48 per 1,000 gal of finished water.

Table X summarizes the estimated overall unit costs of the various methods considered in this article together with the cost estimated by the Saline Water Conversion Program to be about the maximum that can be borne by municipalities. It should be remembered, however, that the estimates given are for production alone and do not include distribution costs.

From the cost analyses here presented, it is seen that the electrodialytic process is at present the most economical means of recovering usable water from water of low salinity. While the overall unit costs of production are high, continuing research and development should improve existing methods or produce newer methods that will permit significant cost reductions. It is not yet possible, however, to recover usable water from moderately saline waters at costs competitive with conventional water treatment and supply methods.

TABLE X. Cost estimates compared

Treatment Methods	Estim. Overall Costs per 1,000 Gal of Finished Water
Multiple-effect evaporation paralleled by sodium zeolite softeners	$2.45
Vapor-compression distillation paralleled by sodium zeolite softeners	0.84
Flash-type distillation paralleled by sodium zeolite softeners	1.37
Ion exchange paralleled by sodium zeolite softeners	0.87
Electrodialysis preceded by sodium zeolite softeners	0.65
Electrodialysis preceded by acid treatment alone	0.48
Saline Water Conversion Program goal for municipal consumption[1]	0.38

REFERENCES

[1] Third Annual Report of the Secretary of the Interior on Saline Water Conversion, Jan. 1955.

[2] G. O. G. Lof, "Demineralization of Saline Water with Solar Energy," Saline Water Conversion Program Research and Development Progress Report No. 4, August 1954.

[3] Review of Research on Problems of Utilization of Saline Water, United Nations Educational, Scientific and Cultural Organization, April 1954.

[4] C. B. Ellis, et al, *Fresh Water from the Ocean*, Ronald Press, 1954.

[5] E. W. Moore, "The Desalting of Saline Waters: a Review of the Present Status," *Journal of New England Water Works Association*, Vol. 65, 1951, p. 319.

[6] Rolf Eliassen, "Reclamation of Saline Waters by Electrodialysis Shows Promise," *Civil Engineering*, Vol. 24, 1954, p. 366.

[7] W. E. Katz, Ionics Inc., private correspondence.

(This article was originally presented by the writers at the ASCE Annual Convention in New York last October, at the joint session of the Inter-American Association of Sanitary Engineering and the ASCE Sanitary Engineering Division, presided over by Ralph E. Fuhrman, chairman of the Division's Executive Committee, and Francis Elder, president of the U.S.A. Section of AIDIS.)

ST. PETERSBURG, FLA., ENLARGES ITS WELL-WATER SUPPLY SYSTEM

PAUL E. LANGDON, M. ASCE
and CARL W. REH, A.M. ASCE

Respectively Partner and Engineer, Greeley and Hansen, Chicago, Ill.

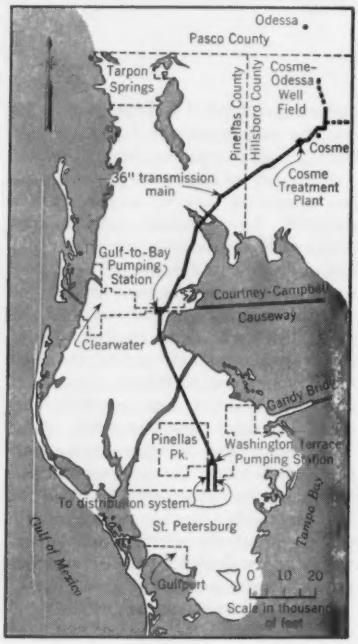


FIG. 1. Water supply system for St. Petersburg, after current enlargement, consists of 17 wells in Cosme-Odessa Well Field, 36-in. reinforced-concrete transmission pipeline, Cosme Treatment Plant and Pumping Station, Gulf-to-Bay booster pumping station, and Washington Terrace distribution pumping station, which also includes three 3.25-million gal steel ground-level reservoirs.

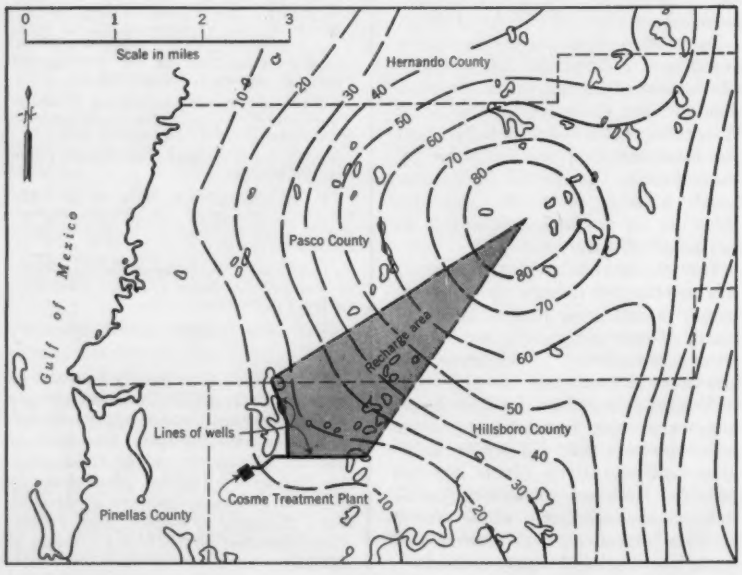
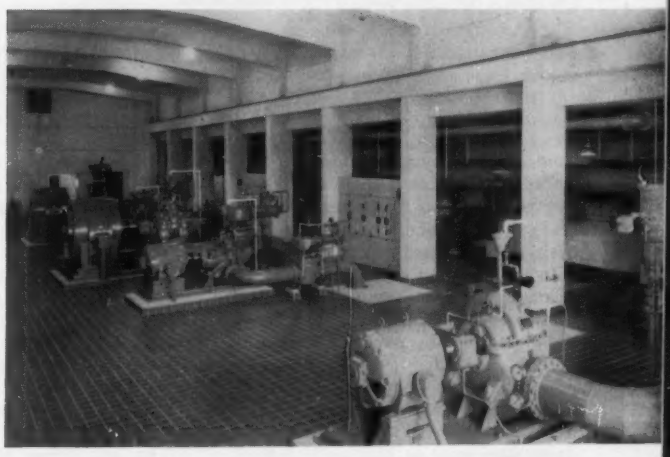


FIG. 2. Contours show estimated piezometric surface of ground water at Cosme-Odessa Well Field with 50 wells producing at rate of 0.67 mgd per sq mile of catchment area. Estimates are based on wells spaced about 700 ft apart on lines shown, and on average yield per well of about 1.0 mgd. At this rate, no intrusion of salt water is anticipated. Rainfall on catchment area is about 57 in. per year.

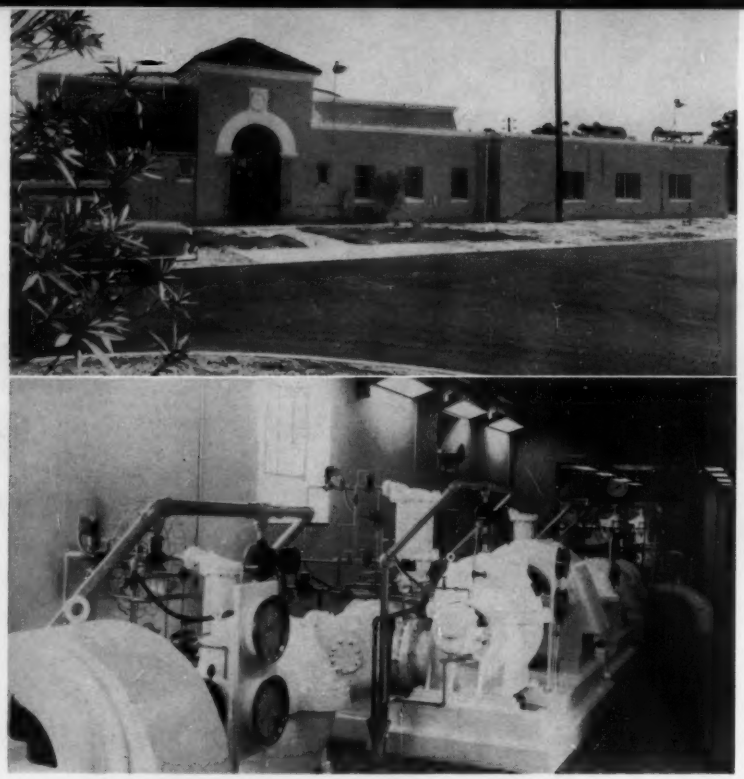


In 1930, when the resident population of St. Petersburg was slightly more than 40,000 persons, the city became acquainted with salt water intrusion into its water supply wells. Located at the end of a peninsula between the Gulf of Mexico and Old Tampa Bay, St. Petersburg was dependent for its water supply on wells within the city limits. Since there is no impervious barrier between the fresh water aquifer and the sea, slight drawdowns of the piezometric surface cause salt water to enter the wells. By 1930 the quality of the water had deteriorated to the point where it became necessary to develop a new source of supply.

The new source was found about 25 miles north-northeast of the center of the city between the small communities of Cosme and Odessa (Fig. 1). The water was moderately hard, about 190 parts per million (ppm), and contained some hydrogen sulfide, but exploration indicated that an ample supply would be available to meet expected future requirements. At that time (1930) the annual average water consumption was about 3.0 mgd.

The original development of the new supply included an aerator and a pumping station at Cosme, a 36-in. reinforced concrete transmission main to the city, and a distribution-system pumping station, near the north city limits, at Washington Terrace. A 3.25-million gal receiving surface reservoir was provided adjacent to the pumping station. Subsequent to this original installation the treatment was expanded, in 1935 and again in 1938, to include softening and filtration. An additional water storage tank of 3.25-million gal capacity was constructed at Washington Terrace and two second-

Cosme Treatment Plant, near well field from which St. Petersburg's water supply is drawn, provides aeration, softening, recarbonation, filtration, chlorination, and fluoridation. In air view at upper left sludge pumping station and solids contact basins are in left foreground, and aerator and storage tanks in right foreground. In left background is pumping station and filter building. Close-up of the latter, at upper right, shows four 4.0-mgd filters, arranged so that additional units can be added. Along front of filters runs recarbonation basin, with recarbonation room below. Filter operating gallery, on far side, is enclosed. Pump room, in same building, is seen in photo directly above. It contains two 20-mgd four-speed units, two 6-mgd units, and a 12-mgd washwater pump. Filter piping is behind columns at right.



Washington Terrace Pumping Station is at city end of St. Petersburg's transmission line, 22½ miles from treatment plant. Recent changes have increased capacity of this, the city's only distribution pumping station, from 27 to 67 mgd without increasing size of structure. In interior view, two of the four old pumps are in foreground and two new 20-mgd pumps and electrical controls are in background.

hand diesel-engine generators were installed to provide emergency power. Between 1930 and 1950 extensions were made to the distribution system, but the basic supply system was not expanded.

In the meantime St. Petersburg had become a major resort center. By 1950 the permanent resident population had increased to about 96,000, and during the peak tourist season, the population was more than 200,000. The average annual water consumption had increased to 8.4 mgd and maximum daily rates were as high as 12.0 mgd. The basic supply system became inadequate, and the city was forced to restrict water use.

Aware of the deficiencies of the water system, the city sought answers to the following principal questions:

1. What are the probable future requirements?
2. Is the present source of supply adequate?
3. What is the best program for development?

Studies of past growth in population and water use and of potential future increases showed that the supply should be capable of development to a capacity approaching 50 mgd. Factors in this conclusion included the following data on past and estimated future water consumption:

	1950	1970	1990
Resident population	95,612	215,000	315,000
Water consumption, mgd:			
Annual average	8.4	19.9	30.5
Maximum month	10.2	25.4	39.2
Maximum day	12.0	29.1	45.9
Maximum hourly rate	20.4	48.3	74.1

The aquifer in the Cosme-Odessa area is composed of several limestones which are stratified and crossed with solution channels. These limestones are recharged by an annual average rainfall on the catchment area of about 57 in. a year. Surface runoff is relatively small so that, except for transpiration and evaporation losses, the major part of the rainfall enters the aquifer, through which it eventually reaches the sea.

The program for developing the aquifer consists of providing a sufficient number of wells to capture a part of the flow to the sea, and limitation of drawdown so that salt water will not intrude. Studies indicated that the safe yield would be about 0.67 mgd per sq mile of catchment area, that wells spaced about 700 ft apart would not materially influence each other, and that the average yield per well would be about 1.0 mgd. For the ultimate development on this basis, more than 50 wells will be required, and it is expected that the effect of this well field will be to lower the piezometric surface as shown in Fig. 2. It was concluded that such a development was safe and economical.

Before the start of the present expansion program, 13 wells supplied the city. Of these two had lost capacity and were replaced with two new ones along the north-south line. An additional well was drilled in the existing field to supplement the supply. Thus at present a total of 17 wells, capable of producing about 18 mgd, are supplying the current average consumption of about 12 mgd. Of the 17 wells, 6 are new ones and 11 are old ones. A seventh new well was drilled at the east end of the field for exploratory purposes.

Further exploration is planned to determine the minimum practical spacing of wells and the relative yields of both the north-south and the east-west lines of wells as proposed. It is also planned to drill a well to salt water and to monitor the salt water elevation continuously. It is expected that, with the determination of safe yield, the monitoring of the salt water and careful operation of the well field, the city will never be forced to abandon this field because of salt-water intrusion.

Treatment-Aeration, filtration, softening

The raw water is moderately hard, the total hardness varying between 180 and 200 ppm. When, in 1935, water softening was adopted, the water was reduced in hardness to about 100 ppm. The advantages of the softened water were considered sufficient to warrant the continuation of softening and, as a result, all plans for future development include this treatment. Besides hardness, the water contains hydrogen sulfide, which is removed by aeration.

The treatment consists of aeration for 100 percent of the water and lime softening, recarbonation, and filtration for about 65 percent of it. The aerated and softened water is mixed to provide a finished water with a hardness of about 100 ppm. The softened water is chlorinated and fluoridated.

The original treatment plant consisted of eight steel tanks, constructed above ground, which were used for aeration, softening, and filtration. In studying methods of expanding the treatment facilities, it was concluded that the construction of additional steel tanks would not be economical.

Instead, it was decided to use the existing tanks for aeration, for solids contact basins for softening, for storage, and to provide rectangular concrete boxes for filters. Four 4.0-mgd filters are included in the initial plant, arranged so that additional units can be added. A recarbonation basin is a part of the filter structure.

The capacity of this recently completed treatment plant is about 25 mgd, and the filters are rated at 3.0 gal per min per sq ft of filter area at this capacity.

Transmission by 36-in. pipeline

The distance between the Cosme Treatment Plant and the Washington Terrace Pumping Station is 118,900 ft (about 22.5 miles) along the route of the existing 36-in. pipeline. The capacity of the pipeline with a pumping station at Cosme is about 20 mgd. but with an intermediate booster station the capacity can be increased to about 26 mgd. When the time comes that the maximum day rate exceeds 26 mgd, it will be necessary to construct a second transmission main to the city.

The Cosme Pumping Station was designed to pump water through the existing main at rates up to 26 mgd, and on construction of a second pipeline, the firm capacity can be increased to 46 mgd. The initial pumping installation consists of two 20-mgd, four-speed pumping units, two 6-mgd pumping units, and a 12-mgd wash-water pump. A third 20-mgd pumping unit will provide the future firm capacity of 46 mgd. Because of the flat terrain, one 20-mgd pump operating at 100 percent, 80 percent, 50 percent and 40 percent of the design speed can deliver water to the city at approximately the average rate for any day. The four-speed units provide flexible and convenient pumping capacity and are economical from the standpoint of both cost of equipment and cost of structure.

Because of the remote location of the Cosme installation and the consequent danger of power outage, an emergency gasoline-engine generator, with a capacity of 250-kw, was installed. This capacity is sufficient to provide a firm water supply to the city of about 12 mgd.

An intermediate line booster station, the Gulf-to-Bay Pumping Station, is now under construction at Gulf-to-Bay Boulevard (Fig. 1). The station is designed to take suction from, and to discharge into the existing pipeline. A 36-in. tilting-disk check valve will prevent recirculation. The station will have three 13-mgd pumping units arranged for remote operation from Cosme. Controls are arranged so that two pumps will operate at any one time—never one, and never three.

Pumping station renovated

In 1950 the distribution pumping station at Washington Terrace contained four pumps with a total rated capacity of 27 mgd. Two 3.25-million gal steel reservoirs at ground level received the water from the transmission main and acted as reserve storage. Two 0.5-million gal elevated tanks were located elsewhere in the distribution system.

The two old diesel-engine generators provided some emergency power, but were unreliable, difficult to operate, and of insufficient capacity to provide power for more than a nominal supply of water in the event of an interruption to the power supply.

Washington terrace was and is the only distribution pumping station serving the city. In the future, on construction of a second main from Cosme, a second pumping station will be provided.

In the meantime, to provide the necessary additional pumping capacity at Washington Terrace, it was concluded that two 20-mgd pumping units should be installed. Because of the possibility of power outages, it was considered necessary to provide adequate, reliable emergency power. By removing the existing diesel-engine generators, sufficient space was made available to house a new 500-kw gasoline-engine generator, two 20-mgd pumps, new electrical controls and switchgear, and chlorine feeders and storage facilities. The remodeling was undertaken, and was successfully completed, while the station remained in operation. The installed capacity of the station was thus increased from 27 to 67 mgd without increasing the size of the structure.

Other improvements in the distribution system included the construction of an additional 3.25-million gal reservoir at Washington Terrace and a third 0.5-million gal elevated tank elsewhere in the system. As a guide to future expansion, a basic distribution-system plan was prepared. Extensions will be constructed as required in conformity with this plan.

Communication in integrated system

The several elements of the water system are widely separated. See Fig. 1. The Cosme Treatment Plant and pumping station is located about 25 miles north of the city and the well field extends 3.5 miles northeast of the treatment plant. The Gulf-to-Bay Pumping Station is about 10 miles north of the city. The Washington Terrace Pumping Station is at the northern limits of the city, and the future West Side Station will be about four miles west of the Washington Terrace Station. The Superintendent's Office is near the center of the city, and the three elevated tanks are dispersed throughout the city.

All these various elements must operate as an integrated system, and the Superintendent must have sufficient information at hand at all times to insure coordination and an adequate supply of water to all parts of the city. Further, the wells must be remotely operated and controlled from the Cosme Plant. Since the operation of the Gulf-to-Bay Station is a part-time operation, and since it is a part of the transmission system, control must be from Cosme. A communications and telemetering system is therefore necessary.

Several methods of communication were studied, including private wires, telephones, and microwave. All methods are practical, but the most feasible and economical was found to be the use of two-wire telephone circuits for all metering and controls. The control of the wells is over city-owned wire from the Cosme Treatment Plant. All other control, telemetering, and communications is over leased Telephone Company circuits. The Gulf-to-Bay Pumping Station is remotely operated from Cosme.

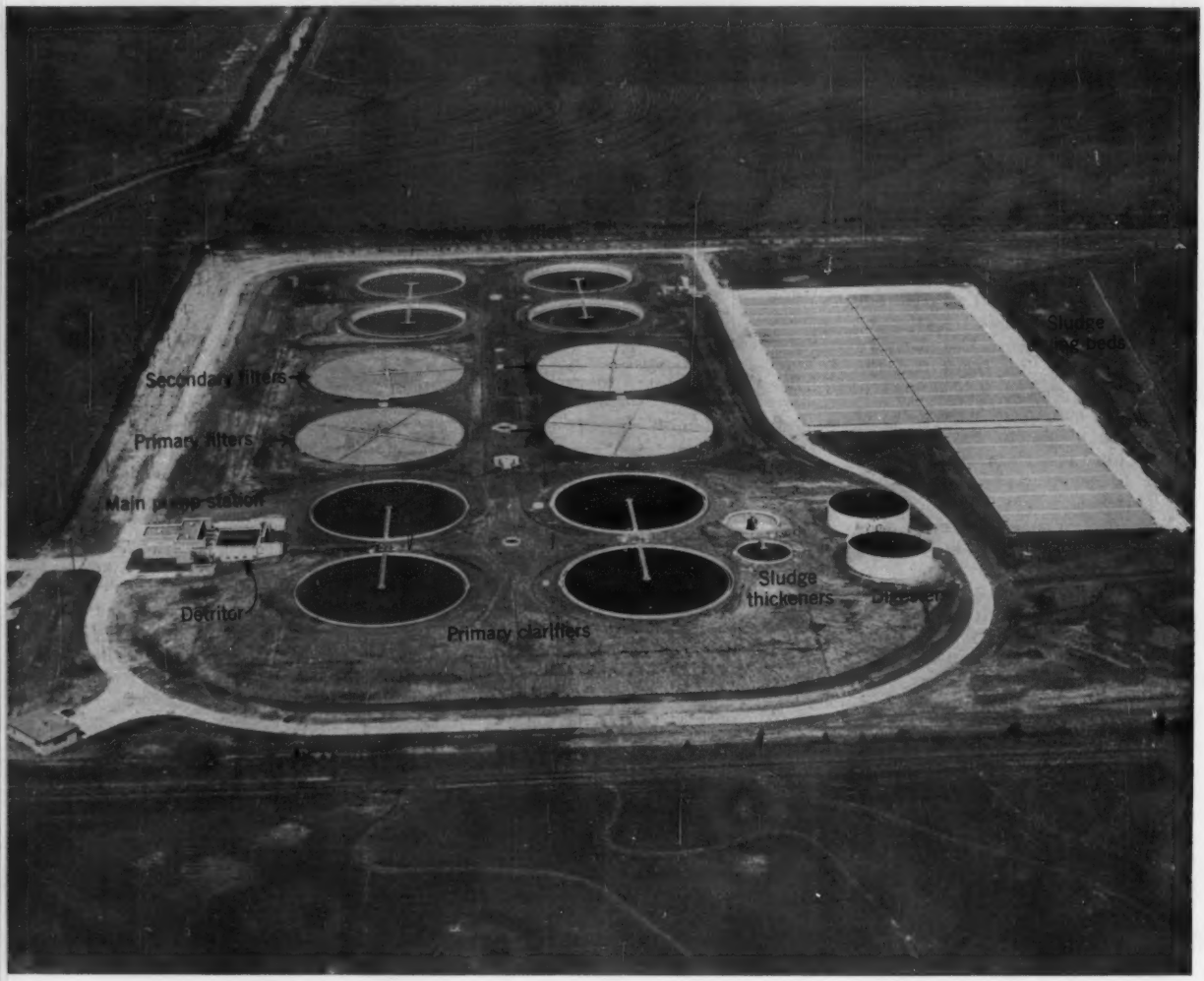
It is believed that the studies of the existing water supply system have developed a program of construction that will maintain an adequate water supply for the City of St. Petersburg, until the year 1990. The program has been conceived so that each element can be expanded in an orderly manner, in accordance with the overall plan, as the need develops. The first two phases of improvement have been completed or are under construction at costs as follows:

Well field (7 wells, collecting main, etc.)	$ 459,520.19
Cosme Treatment Plant and Pumping Station	2,491,017.84
Gulf-to-Bay Pumping Station	271,279.72
Washington Terrace Pumping Station	375,146.24
3.25-million gal reservoir	100,590.00
0.5-million gal elevated tank	118,743.50
Communications	51,500.00
Total	$3,867,797.49

With these improvements and additional wells, the system will supply about 26 mgd on a maximum day, which is expected to be adequate until about 1965, at which time further treatment and transmission facilities will be necessary. Well-field extensions are planned at two- or three-year intervals in advance of requirements.

The engineering work for the improvements here described was carried out by Greeley and Hansen under the direct supervision of the writers.

Sludge thickening proves economical in Beaumont,



Sewage treatment plant for Beaumont, Tex., completed in 1955, utilizes sludge thickening process which, estimates indicate, resulted in saving of $175,000 in plant construction cost.

Tex., sewage treatment plant

JOE DUST
Superintendent of Sewage Treatment Plant, Beaumont, Tex.

Sludge thickening for the purpose of reducing expensive digester capacity has been designed into the new 30-mgd (average flow) sewage treatment plant, placed in operation in June 1955 by the City of Beaumont, Tex. This new sludge thickening process resulted in a saving of $175,000 in construction cost of the plant over a comparable conventional design without thickeners. In the first six months of operation the thickener has produced a concentrated sludge for digestion averaging 8.7 percent solids, and indicating that the results should continue to exceed the design value of 7.5 percent solids. The thickening process has resulted in no deleterious operating characteristics in other plant units.

Why sludge thickening?

The need for sludge thickening prior to digestion has been recognized for many years. References to it can be found in numerous published articles, usually describing digestion troubles resulting from sludge containing too low a percentage of solids—that is, too much water. In discussing the digester supernatant problem, C. V. Erickson (in *Sewage Works Journal*, September 1945) pointed out the inverse relationship between the volume of supernatant liquor produced and the percentage of solids entering and leaving a digester. He described the need for reducing the liquid volume of the sludge going to a digester. However he stated that when an effort is made to obtain this concentration in settling tanks, the sludge becomes septic, rises to the surface, and is carried out in the tank effluent. He predicted that any practical attempt to thicken sludge would necessarily be along the line of an intermediate process rather than in settling tanks.

David W. Carmichael, A.M. ASCE, also experienced difficulties while attempting to thicken sludge in settling tanks, and he wrote (in *Sewage Works Journal*, July 1944) that sludge remaining in sedimentation tanks too long becomes septic, gasifies, and rises in large pieces to the surface. He noticed that this was particularly true in the summer months.

In a paper dealing with the important operational phases of the sludge problem (in the same publication referred to above, the same issue) H. Heukelekian stated:

"The frequent removal of sludge from sedimentation tanks is essential and is now generally recognized as good practice. The disadvantages arising from infrequent removal of sludge are: (*a*) deterioration of the effluent, (*b*) scum formation in sedimentation tanks, and (*c*) possible retardation of digestion.... The frequent removal of sludge, on the other hand, is usually accompanied by a sludge of low solids concentration, entailing the addition of large volumes to the digester and resulting in cooling the tank contents and reduction in the capacity of the tank....If maximum concentration of sludge is desired, thickening in separate or especially designed hopper tanks before addition to the digester is called for."

In a discussion of the required digester capacity (*Manual for Sewage Plant Operators*, Texas Water and Sewage Works Assoc., 2nd Edition, p. 247), E. J. M. Berg says, "... size is not solely determined by the amount of matter to be digested, but also by the concentration of the sludge. Often digester troubles may be traced to insufficient concentration of the sludge added."

Thus it has been recognized by men connected with different phases of sanitary engineering that sludge going to the digesters should contain a high percentage of solids and should be removed from the clarifiers as soon as possible to prevent septic action from taking place. A saving in digester capacity is evident, if thicker sludge for digestion could be obtained in normal plant operation.

In seeking the solution to the treatment of sewage sludge, according to the procedure outlined, Wilbur N. Torpey, M. ASCE, developed a new process of sludge concentration, at the Bowery Bay Sewage Treatment Works in New York, that was amenable to controlled plant operation. Mr. Torpey reported the results of his new method of thickening sludge in the ASCE *Proceedings-Separate* No. 443 (1955). With this new process in operation he also reported (in *Sewage and Industrial Wastes*, April 1954) that one digester operating alone successfully handled all the sludge from the plant where previously four digesters of similar size were inadequate and were hopelessly overloaded.

The design engineers realized that there would be a saving in expensive digester capacity if the process for obtaining a denser sludge could be utilized. The answer to the quantitative questions, as to how much the saving in digester capacity, and the resulting monetary saving, would be, are plotted from the plant design notes in Fig. 1. This curve indicates the relationship between the required capacity of the digesters and the percentage of sludge solids in the feed to the digester. These design computations were based on the methods outlined in ASCE *Transactions*, Vol. 103, page 1701, and the percentage reduction of volatile matter in digestion tanks as reported by R. S. Rankin (*Sewage Works Journal*, May 1948). Other design information includes:

Design population	200,000
Suspended solids, per capita per day	0.20 lb
Suspended solids removed in clarifiers	90%
Volatile solids in sludge to digesters	65%
Digestion period	20 days
Maximum interval between sludge withdrawals	15 days

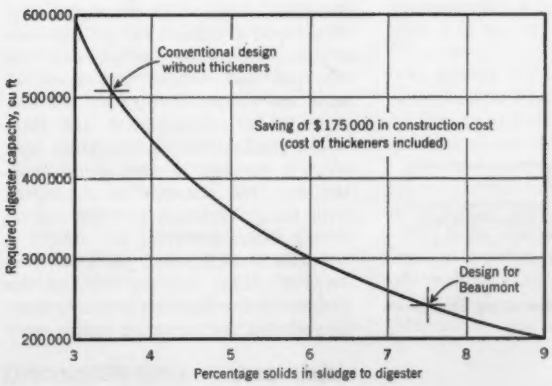


FIG. 1. This curve was plotted to answer questions as to how much the sludge densifying process would save in digester capacity and in overall plant cost.

Detritor, in foreground, has diameter of 40 ft. It adjoins main pumping station.

Valve chamber contains four 36-in. Rodney Hunt sluice gates. Such gates, also used in other parts of plant, seat on resilient neoprene mat, flush with bottom of channel, particularly advantageous in flat terrain.

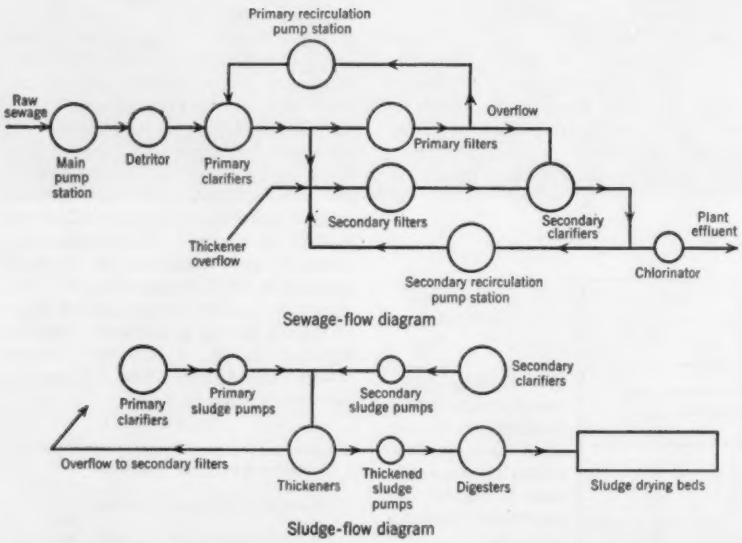


FIG. 2. Flow diagrams for sewage and sludge indicate method of operating Beaumont treatment plant.

The State of Texas Department of Health was very cooperative in giving favorable consideration to the plans for two 80-ft-diameter digesters containing 255,500 cu ft, and V. M. Ehlers, M. ASCE, Director of the Department's Bureau of Sanitary Engineering, under date of March 16, 1953, wrote the consulting engineer, George J. Schaumburg, as follows:

"We are aware that there is considerable research now under way in this (digestion) phase of sewage treatment, and quite possibly within the next few years developments will be made which will result in a revision of some of our basic design figures. In view of this, as well as the expenditures required for the construction of digesters, it occurs to us that the city might wish to construct the digesters as proposed so that studies and investigations might be made during the next several years of operation for use in determining the adequacy of these units. Should the city give favorable consideration to this suggestion, this Department would offer no objections to such a proposal."

"With reference to the installation of sludge thickeners, we realize that, in theory, this device should aid materially in reducing the amount of liquid ordinarily discharged to digesters with sludge. By concentrating the sludge, the volume ordinarily taken up in the digester by such liquid is utilized for the digestion of the concentrated sludge, and this also will undoubtedly have an effect upon the volume of digestion capacity needed. It is unfortunate that there is not available actual operating data from a number of treatment plants utilizing this principle in connection with sludge digestion and disposal on drying beds; however, we believe it warrants consideration, particularly in view of claims that by utilizing this process the two digesters proposed might be sufficient for the entire design popu-

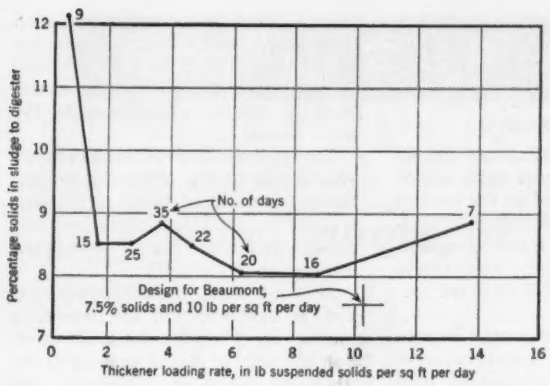


FIG. 3. Curve plots interrelation between solids loading to thickener and amount of sludge concentration. Rather constant percentage of solids in thickened sludge is indicated as suspended solids loading to thickener increases. Note that results are better than assumed in design.

lation of 200,000. Since we have little actual operating data along these lines we would suggest that if this process is to be included in the project, operating and laboratory data be obtained during the next several years so as to fully evaluate this unit."

Operation good from the start

The aerial photograph shows Beaumont's high-rate bio-filtration sewage treatment plant shortly after the start of operation. The sewage enters the plant site through two 60-in. and one 27-in. reinforecd concrete lines and then flows through two mechanically cleaned bar screens in the main pump station, shown near the entrance road at the left of the photograph. Also located in this station are four raw-sewage pumps having capacities of 10, 10, 15, and 20 mgd. The pumps discharge to a detritor of 40-ft diameter designed to remove the grit. The sewage then flows through a 5-ft Parshall measuring flume before going to four primary clarifiers of 155-ft diameter, shown in the central foreground. The primary clarifier effluent is split two ways, part going to two primary filters of 195-ft diameter and the rest to two secondary filters, also of 195-ft diameter. The primary-filter effluent is recirculated to the primary clarifiers, and the secondary-filter effluent flows by gravity through four secondary clarifiers of 155-ft diameter shown in the background. The flow then goes to the secondary recirculation pump station, located to the right of these clarifiers. A part of the sewage entering this pump station is recirculated back to the secondary filters, and the remainder is discharged, after chlorination, to a bayou.

Sludge from the primary and secondary clarifiers is pumped to the two sludge thickeners, of 50-ft diameter, shown to the right of the primary clarifiers. One thickener was empty at the time the aerial photograph was taken. Two digesters of 80-ft diameter are located to the right of the thickeners, and the 28 sludge drying beds appear at the far right. The administration and laboratory building is in the lower left corner of the photo. Sewage-flow and sludge-flow diagrams are shown in Fig. 2.

Plant construction was completed and sewage treatment begun on June 8, 1955. Records of plant operation were kept starting July 1, and one of the sludge thickeners was placed in operation on July 15. As the flow of sewage and solids to the plant during the first months of operation were considerably under those expected, only one thickener was operated for the rest of the year. The low sewage flow was due to two reasons: first, the entire city had not been connected to the sewage plant and, second, several unusually dry months were experienced during this period. The sewage flow, along with other data on the amount of suspended solids and bio-chemical oxygen demand in the raw sewage, and equivalent population, is given on Table I.

Operation of the thickener from July 15 to December 31, 1955, is separated into three periods for comparison of records: (1) August 1–12, (2) July 15–31 and August 13–November 30, and (3) December 1–31. The sludge thickening records of August 1–12 are not included in the reported results. During these twelve days the secondary digester was quickly filled with thin sludge, in order to stop digester gas from escaping to the atmosphere, and no attempt was made to obtain a thickened sludge.

As the sludge thickening process operated from the start with satisfactory results, the sludge thickener required very little operating attention. This routine operation lasted from July 15 to December 1, and consisted mainly of a daily check on the depth of the sludge blanket in the thickener. The time clocks on the thickened sludge pumps were then set to remove a quantity of thickened sludge during the next 24 hours, equal to the volume of the sludge in the blanket. The sludge blanket test is easy to make, as the separation of the sludge from the liquid above it forms a very distinct line. The test is made by lowering a marked end of a pump suction hose into the thickener and visually observing the liquid discharged by the pump. When the sludge blanket is reached, the material discharged by the pump changes from a clear liquid to a black sludge.

In an attempt to find whether thickener operation could be improved by more careful attention, a control program was inaugurated on December 1, and carried out the rest of the year. As the solids in the feed to the thickener were found to vary widely throughout the day, a settleable solids test was taken every two hours on the thickener influent. This information aided the operators in controlling the level of the sludge blanket at a constant depth throughout the day. Previous to this, the volume in the sludge blanket fluctuated considerably between measurements.

As good operation of the thickener depends on keeping the sludge in an aerobic state, dissolved oxygen determinations were made during December, on the thickener influent and overflow. The operator made these determinations at the start of his shift, and accordingly adjusted the amount of secondary clarifier sludge pumped to the thickener. If the dissolved oxygen at either of the two sampling points was zero, plant water (final effluent) was admitted to the thickener to return the tank contents to an aerobic state.

This controlled operation increased

TABLE I. Sewage flow and other data, July–Dec. 1955

Month 1955	Raw-Sewage Flow, mgd	Sus. Solids in Raw Sewage, lb per day	B.O.D., lb per day	Equiv. Population
July	2.7	2,360	4,630	27,000
Aug.	5.4	6,890	9,960	58,500
Sept.	6.1	9,470	10,880	64,000
Oct.	7.1	12,050	13,000	76,500
Nov.	7.5	13,900	12,500	73,500
Dec.	9.7	15,500	14,000	82,500
Expected 1955 aver.	10.6	23,000	19,500	115,000
Plant design	30.0	40,000	34,000	200,000

TABLE II. Percentages of volatile and total solids in thickened solids

Period, 1955	Percentage Vol. Solids	Percentage Total Solids
July 15–31	50	10.1
Aug. 13–31	46	8.9
Sept. 1–30	45	7.6
Oct. 1–31	59	6.9
Nov. 1–30	59	7.6
Dec. 1–31	55	11.5
Average	52	8.7

TABLE III. Raw sewage and thickener overflow compared

	B.O.D., ppm	Suspended Solids, ppm
Raw sewage	208	173
Thickener overflow	130	98

TABLE IV. Gas production from digesters

Month	Gas Produced, cu ft per day	Equiv. Population	Gas Produced, cu ft per cap.
Aug.	18,100	58,500	0.31
Sept.	26,800	64,000	0.42
Oct.	44,100	76,500	0.58
Nov.	54,000	73,500	0.73
Dec.	69,800	82,500	0.85
Plant design	226,000	200,000	1.13

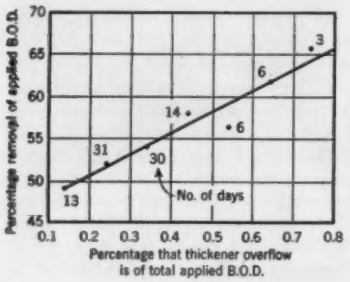


FIG. 4. Comparison indicates thickener overflow has no deleterious effect on B.O.D. removal in secondary filter.

the solids in the thickened sludge to 11.5 percent during December, a very definite increase over the preceding months. This is shown in Table II.

Evaluation of the thickener

Unfortunately, the thickener and its effect on other treatment units cannot be completely evaluated on the basis of only six months of operation. However, the records of these first six months can be plotted to determine if any trends are developing which will aid in the ultimate evaluation.

Perhaps the most important item to consider is the sludge concentration as indicated by the percentage of total solids. To determine this, samples of the thickened sludge were taken every two hours for the entire period of thickener operation, and were composited at the end of each day. The percentage of total solids and the percentage of volatile material were determined from these daily composited samples. These results also are given in Table II.

Another item to be considered in the evaluation of the thickener is the relationship between the percentage of volatile solids and the percentage of total solids in the thickened sludge. It is conceivable that an inverse relationship should develop between the amount of volatile material in the sludge and the thickening of this material. However, a very erratic curve results from the plotting of volatile solids against percentage of solids in the thickened sludge. More information will be required to determine this relationship, if it exists to any extent.

Next to be determined is the possible existence of a trend between the solids loading to the thickener and the amount of sludge concentration. These data are plotted in Fig. 3. After the first point of low loading, Fig. 3 shows a rather constant percentage of solids in the thickened sludge as the suspended solids loading to the thickener increases. It also shows that the results of the sludge thickening process are better than the conditions established for the plant design.

The thickener overflow has an appearance similar to that of the raw sewage, but its suspended solids and B.O.D. content are less than those of the raw sewage received at the plant. A comparison is given in Table III.

As shown in Fig. 2, the thickener overflow is discharged to the secondary filters. To determine how this overflow affected the B.O.D. removal of the secondary filters, a comparison was made between the percentage the thickener overflow is of the total B.O.D. applied, and the percentage removal of B.O.D. in the secondary filter. This comparison, shown in Fig. 4, indicates that the thickener overflow has no detrimental effect on the removal of B.O.D. in the secondary filter.

Sludge pumping to the digester started at the ideal time of the year, so it may not be surprising that the digesters operated trouble free from the start. Gassing started almost immediately and has continued at a steadily increasing rate for the remainder of the year. The gas production is metered and is given in Table IV.

The first digested sludge was withdrawn to a drying bed on October 31, and by the end of the year enough to fill nine beds had been drawn off. The sludge withdrawn averaged 9.1 percent solids and 37 percent volatile material. Even with one bed containing 12.0 percent solids, no difficulties were encountered in withdrawing the sludge or in the drying process.

Complete evaluation of the thickening process will require more time, as indicated by the State Department of Health, and it should be interesting to follow the results of digester operation as the load on the plant increases.

All the evaluation data, to date, show that the design engineers exercised good engineering judgment in recognizing the value of this new sludge thickening process (Fig. 5), and introducing it for the time first in the design of a new plant.

The Consulting Engineer for the $2,400,000 plant, part of a $6,500,000 sewerage construction project, was George J. Schaumburg of Beaumont, Tex., and the Engineering Consultants for the sewerage treatment plant were Forrest and Cotton of Dallas, Tex. The General Contractor was the Tellepsen Construction Company of Houston, Tex.

(This article was originally presented by Mr. Dust as a paper at the ASCE Convention in Dallas, Tex., before the Sanitary Engineering Division session presided over by Ray E. Lawrence a member of the Division's Executive Committee.)

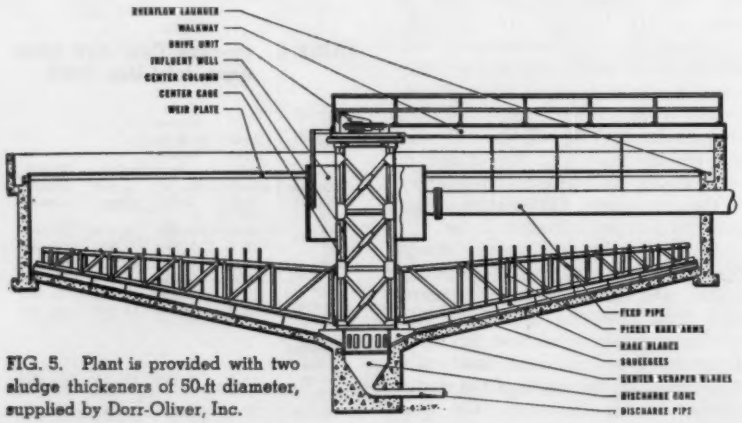


FIG. 5. Plant is provided with two sludge thickeners of 50-ft diameter, supplied by Dorr-Oliver, Inc.

Finding angle of fabricated pipe bend

LAWRENCE P. JOHNSON, JR., A.M. ASCE

Senior Design Engineer, Metropolitan District Commission, Hartford County, Conn.

In many pipline jobs, it is necessary or desirable to combine a plan and profile deflection in one fitting. The relationship then between θ (the angle of the fabricated pipe bend), α and β (the deflection angles in the plan and profile respectively) and γ (the slope angle of one leg of the bend) must be known. I have found that many approximate relationships are used, but unless the exact relationship is known, it is impossible to tell how approximate they are.

A simple relationship is illustrated in Fig. 1, with its derivation. If β increases the slope angle relative to γ, it bears a plus value as shown in Fig. 1.

Note that, since the profile is not cut on $B'C'$, $B''C''$ does not slope at γ, but at a new angle, γ'. The relationship is:

$$\tan \gamma' = \frac{\tan \gamma}{\cos \alpha}$$

Now construct a horizontal line on the profile from C'' to $A''B''$, intersecting at X''. Project X'' on the plan, where $C'X'$ is the true length of CX.

Note on the plan that $B'C'$ is the horizontal projection of BC, which makes an angle, γ, with the horizontal. Therefore the true length of BC is $\frac{B'C'}{\cos \gamma}$. Note on the profile that the true length of BX is $B''X''$.

All that remains now is to develop equations for the true length of the three sides of the triangle BCX in terms of α, β and γ. Assuming that $B'C'$ can be a term common to all:

$$BC = \frac{B'C'}{\cos \gamma} \text{ (from above)} \quad . . (1)$$

Note on the profile that $D''C'' = E''X'' = B'C' \tan \gamma$; and

$$B''X'' = \frac{E''X''}{\sin (\gamma + \beta)}. \text{ Hence}$$

$$BX = \frac{B'C' \tan \gamma}{\sin (\gamma + \beta)} \quad . . . (2)$$

Note on the plan that $A'X' = A'B' - B'X'$; and $A'B' = B'C' \cos \alpha$. Hence $A'X' = B'C' \cos \alpha - B'X'$.

Note on the profile that $B'X' = B''E'' = \frac{E''X''}{\tan (\gamma + \beta)} = \frac{B'C' \tan \gamma}{\tan (\gamma + \beta)}$.

Therefore $A'X' =$

$$B'C'\left[\cos \alpha - \frac{\tan \gamma}{\tan (\gamma + \beta)}\right]$$

Note on the plan that

$$C'A' = B'C' \sin \alpha. \text{ Since}$$

$$C'X' = [(A'X')^2 + (C'A')^2]^{1/2}$$

then, $CX = B'C' \times$

$$\left\{\left[\cos \alpha - \frac{\tan \gamma}{\tan (\gamma + \beta)}\right]^2 + \sin^2 \alpha\right\}^{1/2}$$

Or simplifying,

$$CX = B'C' \times$$

$$\left[1 - \frac{2 \tan \gamma \cos \alpha}{\tan (\gamma + \beta)} + \frac{\tan^2 \gamma}{\tan^2(\gamma + \beta)}\right]^{1/2} \quad . . . (3)$$

Now on any oblique triangle, BCX, if θ is the angle opposite to side CX,

$$\cos \theta = \frac{(BC)^2 + (BX)^2 - (CX)^2}{2\,(BC)\,(BX)}$$

Substituting in Eqs. 1, 2 and 3, and letting $B'C'$ equal unity,

$$\cos \theta = \frac{\frac{1}{\cos^2 \gamma} + \frac{\tan^2 \gamma}{\sin^2 (\gamma + \beta)} - 1 + \frac{2 \tan \gamma \cos \alpha}{\tan (\gamma + \beta)} - \frac{\tan^2 \gamma}{\tan^2 (\gamma + \beta)}}{2\left[\frac{1}{\cos \gamma}\right]\left[\frac{\tan \gamma}{\sin (\gamma + \beta)}\right]}$$

Dividing through and simplifying,

$$\cos \theta = \sin \gamma \sin (\gamma + \beta) + \cos \gamma \cos (\gamma + \beta) \cos \alpha. \quad . (4)$$

which is the equation for the general case. For the special case when γ equals zero, $\cos \theta = \cos \beta \cos \alpha$. For the special case when β equals zero, $\cos \theta = \sin^2 \gamma + \cos^2 \gamma \cos \alpha$.

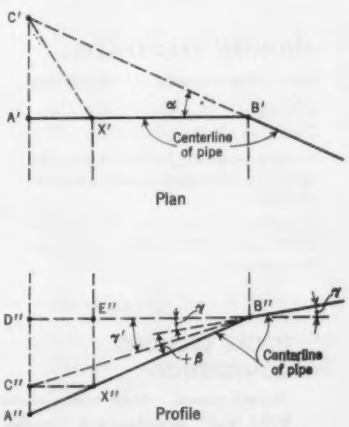


FIG. 1. Plan and profile of bend in a pipe, on centerline of pipe.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Knoxville Convention

TENNESSEE VALLEY SECTION, HOST

Knoxville, Tenn. **University Center** **June 4–8, 1956**

REGISTRATION

Hotel Andrew Johnson, Upper Lobby

Sunday, June 3, 4:00 to 6:00 p.m.

Monday, June 4, 8:30 a.m. to 3:00 p.m.

University Center, First Floor Lobby

Tuesday through Thursday, June 5–7, 8:30 a.m. to 5:00 p.m.

Friday, June 8, 8:30 a.m. to noon.

Registration fee, for members, $3.00. (Ladies and students are exempt from the fee.)

ADVANCE ATTENDANCE INFORMATION

To help make adequate preparation for the Knoxville Convention, the Committee urges all members planning to attend to let us know as soon as possible. Please fill out the coupon on page 136 and mail it to Robert H. Nagel, Registration Chairman. No obligation is attached to your use of this coupon. Your help will be greatly appreciated.

AUTHORS' BREAKFASTS

University Center Cafeteria **Ground Floor**

8:00 a.m. Tuesday, Wednesday, Thursday, Friday.

Briefing sessions, by invitation, for speakers, discussers, and program officials.

Presiding: Gale B. Dougherty, Chairman, Technical Program Committee.

LOCAL SECTIONS CONFERENCE

Assembly Lounge **Hotel Andrew Johnson**

9:30 a.m., Monday and Tuesday, June 4 and 5.

Representatives of the Local Sections and Branches of ASCE located in the area about the Convention city will convene to discuss the expanding activities of the Society at local level. This conference, which is primarily for invited delegates of selected sections, will be open to all who may be interested in the activities and operational details of ASCE Local Sections.

LOCAL SECTIONS CONFERENCE LUNCHEON

Grand Ballroom **Hotel Andrew Johnson**

12:15 p.m. Monday, June 4

This luncheon will provide an opportunity for local Sections Conference delegates to enjoy social contacts with each other and the National Society officers.

Presiding: GEORGE P. PALO, President, Tennessee Valley Section, ASCE.

Speaker: WILLIAM H. WISELY, Executive Secretary, ASCE.

Subject: Headquarters Services to Local Sections.

All delegates, early arrivals, guests, and friends of the ASCE are cordially invited. Per plate, $2.00.

COMMITTEE MEETINGS

Room 216 **University Center**

2:15 p.m. Tuesday, June 5

Committee on "Irrigation and Drainage Practices in Humid Areas," Irrigation and Drainage Division.

All Technical Sessions will be held on the campus of University of Tennessee

TUESDAY MORNING JUNE 5

Power Division

9:00 a.m. **Grille, University Center**

Presiding: Edgar S. Harrison, Member, Executive Committee, Power Division

9:00 The Kamishiiba Arch Dam, Japan

CHARLES C. BONIN, A.M. ASCE, Chief Civil Engineer; HARRY W. STUBER, A.M. ASCE, Design Engineer; and K. M. MATHISEN, Construction Engineer; Ebasco Services, Inc., New York, N. Y.

Results of Measurements on Kamishiiba Dam

H. KIMISHIMA, Civil Engineer, Kyushu Electric Co., Japan

Portuguese Experience with Overflow Arch Dams

A. C. XEREZ, Chief Engineer, Hidro Electrica do Zezere, Portugal.

Waterways Division

9:15 a.m. **Moot Court, Law Building**

9:15 Apalachicola River Basin Project

C. P. LINDNER, M. ASCE, Chief Engineer, South Atlantic Div., Corps of Engineers, Atlanta, Ga.

9:45 Discussion

9:55 Design of Tainter Gates and Anchorages

ALEXANDER N. KENIGSBERG, M. ASCE, Design Engineer, Nashville Dist., Corps of Engineers, Nashville, Tenn.

10:25 Discussion

10:35 Modern Towboat and Barge Design and Its Effect on Growth of Waterborne Commerce

HARRY B. DYER, M. ASCE, President, Nashville Bridge Co., Nashville, Tenn.

11:05 Discussion

11:15 Design Considerations for New Lock at Wilson Dam on Tennessee River

ROBERT A. MONROE, M. ASCE, Chief Design Engineer; and GEORGE P. PALO, A.M. ASCE, Head Civil Engineer; Tennessee Valley Authority, Knoxville, Tenn.

11:45 Discussion

Irrigation and Drainage Division

9:30 a.m. **Room 103, Law Building**

Presiding: H. T. Critchlow, Member, Executive Committee, Irrigation and Drainage Division

9:30 Martin County (Florida) Irrigation Experience

W. TURNER WALLIS, M. ASCE, Central and Southern Florida Flood Control Dist., West Palm Beach.

10:15 Construction Problems and Costs Related to Irrigation Development

of Large Projects through Use of Ground Water

FRED W. BAILEY, Peerless Supply Co. Inc., Shreveport, La.

11:00 Estimating Drought Probability from Rainfall and Evapo-Transpiration Data

W. H. DICKERSON, Professor, Dept. of Agricultural Eng., West Virginia Univ., Morgantown, W. Va.

TUESDAY AFTERNOON
JUNE 5

Power Division

2:00 p.m. Grille, University Center

Presiding: J. J. Martin, A.M. ASCE, Civil Engineer, Bureau d'-Etudes, A. Coyne and Bellier, Paris, France

2:00 Design and Construction of Ross Dam

C. E. SHEVLING, Dept. of Lighting, City of Seattle, Wash.

L. R. SCRIVNER, Concrete Dams Section, U. S. Bur. of Reclamation, Denver, Colo.

Stress Measurements at Ross and Diablo Dams

C. E. SHEVLING, Dept. of Lighting, City of Seattle, Wash.

JOE T. RICHARDSON, A.M. ASCE, Concrete Dam Section, U. S. Bur. of Reclamation, Denver, Colo.

OWEN J. OLSEN, Engineering Labs., U. S. Bur. of Reclamation, Denver.

Waterways Division

2:00 p.m. Moot Court, Law Building

2:00 Developments in Waterborne Commerce and Terminals on Tennessee and Cumberland Rivers

GILBERT M. DORLAND, M. ASCE, Colonel, Corps of Engineers; District Engineer, Nashville District, Nashville, Tenn.

G. R. BETHURUM, Civil Engineer, Nashville District, Corps of Engineers.

2:30 Discussion

2:40 Harrison County, Alabama, Seawall Protection

F. P. ESCOFFIER, Chief, Hydraulic Section, Mobile District, Corps of Engineers, Mobile, Ala.

3:10 Discussion

3:20 Cumberland River Development Plan

F. P. GAINES, A.M. ASCE, Chief, Engineering Div., Nashville District, Corps of Engineers.

J. T. DENNISON, A.M. ASCE, Asst. Chief, Engineering Div., Nashville District, Corps of Engineers.

3:50 Discussion

4:00 Lower Cumberland Project

A. E. DYKES, Chief, Planning and Reports Branch, Nashville District, Corps of Engineers.

4:30 Discussion

Highway Division

2:00 p.m. Room 233, Business Admin. Bldg.

Presiding: N. W. Dougherty, M. ASCE, Dean of Engineering, Univ. of Tennessee

2:00 American Transportation—Mass in Motion

H. H. HALE, M. ASCE, Asst. to Vice President, Assoc. of Amer. Railroads, Washington, D. C.

2:30 Discussion

2:40 Long-Time Highway Studies

W. M. LEACH, Commissioner, Tenn. Dept. of Highways and Public Works, Nashville, Tenn.

3:10 Discussion

3:20 The Case of the Interstate System of Highways

A. E. JOHNSON, M. ASCE, Executive Secretary, Amer. Assoc. of State Highway Officials, Washington, D. C.

3:50 Discussion

4:00 Traffic Generation Characteristics and Thoroughfare Planning for Urban Areas

W. F. BABCOCK, A.M. ASCE, Prof. of Civil Eng., North Carolina State College, Raleigh, N. C.

4:30 Discussion

Hydraulics Division

2:00 p.m. Room 104, Law Bldg.

Presiding: Joe W. Johnson, M. ASCE, Member, Committee on Research, Hydraulics Division

Session on Research

2:00 Comprehensive Discharge Characteristics of Rectangular-Notch Weirs

CARL E. KINDSVATER, M. ASCE, Regents Prof. of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.

2:30 Discussion

2:45 Civil Engineering in the Nuclear Power Age

CARLOS G. BELL, JR., A.M. ASCE, Asst. Prof. of Civil Eng., Northwestern Univ., Evanston, Ill.

3:15 Discussion

3:30 Some Characteristics of the Hydraulic Jump at an Abrupt Drop in a Rectangular Channel

WALTER L. MOORE, A.M. ASCE, Prof., Dept. of Civil Eng.; and CARL W. MORGAN, A.M. ASCE, Asst. Prof., Dept. of Civil Eng.; Univ. of Texas, Austin, Tex.

4:00 Discussion

Structural Division

2:00 p.m. Room 135, Business Admin. Bldg.

Presiding: Armour T. Granger, Chairman, Session Programs Committee, Structural Division

2:00 Design Features of Large Steam Plant Powerhouses

ERNEST M. TITUS, M. ASCE, Asst. Head Structural Engineer, TVA, Knoxville, Tenn.

2:40 Design Features of a Tall Office Building

ROSS H. BRYAN, M. ASCE, Consulting Engineer, Nashville, Tenn.

3:20 Design Features of an Unusual Tower

GIBSON MORRIS, Chief Engineer, Oak Ridge National Labs., Oak Ridge, Tenn.

4:00 General discussion

WEDNESDAY MORNING
JUNE 6

Welcome Session

9:15 a.m. Grille, Univ. Center

Presiding: George P. Palo, President, Tennessee Valley Section

9:15 Welcome by Tennessee Valley Section

GEORGE P. PALO, A.M. ASCE, President, Tenn. Valley Section.

9:20 Welcome to University

DR. C. E. BREHM, President, University of Tennessee.

9:30 Response

ENOCH R. NEEDLES, President, ASCE.

General Session

9:45 a.m. Grille, Univ. Center

Sponsored by Department of Conditions of Practice

Presiding: Frank L. Weaver, Vice President, Zone II; Chairman, Dept. of Conditions of Practice.

Panel on Responsibilities of the Engineering Employer and Employee to Each Other

MODERATOR: WILLIAM F. MOEHLMAN, A. M. ASCE, Vice Pres., Tenn. Metal Culvert Co., Knoxville, Tenn.

9:45 An Employer's View—Public Office

HARRY A. WIERSEMA, M. ASCE,

Asst. to Chief Engineer, TVA, Knoxville, Tenn.

An Employee's View—Public Office

THOMAS B. LEE, J.M. ASCE, Civil Engr., City Dept. of Public Works, Nashville, Tenn.

An Employer's View, Private Office

KENNTH V. HILL, M. ASCE, Member, Greely & Hansen, Chicago, Ill.

An Employee's View, Private Office

CECIL U. MOORE, Jr., J.M. ASCE, Structural Engr., Hayes, Seay, Mattern and Mattern, Engineers, Architects, Roanoke, Va.

CONVENTION LUNCHEON

Wednesday, June 6

12:15 a.m. Volunteer Ballroom, Univ. Center

Presiding: Enoch R. Needles, President of ASCE

Speaker: NATHAN W. DOUGHERTY, M. ASCE; Dean, College of Engineering, Univ. of Tenn., Knoxville, Tenn.

Subject: Educating a Professional Engineer

All members, their ladies, and guests, and friends of ASCE are cordially invited to attend.

Per plate, $2.50. Tickets for this event must be purchased before 10:00 a.m. on Wednesday.

General Technical Session

2:15 p.m. Grille, Univ. Center

Presiding: C. E. Blee, M. ASCE, Chief Engineer, TVA, Knoxville

Symposium on Multiple-Purpose River Development

2:15 Role of the Civil Engineer in Multiple-Purpose River Development

HERBERT D. VOGEL, M. ASCE, Chairman of the Board, TVA, Knoxville, Tenn.

2:35 TVA Experience in Multiple-Purpose River Development

REED A. ELLIOT, M. ASCE, Chief Water Control Planning Engineer, TVA, Knoxville, Tenn.

3:00 Success of the TVA Experiment

G. O. WESSENAUER, A.M. ASCE, Manager of Power, TVA, Chattanooga, Tenn.

3:20 Future of Multiple-Purpose Development

GAIL A. HATHAWAY, M. ASCE, Special Asst. to Chief of Engineers, U. S. Army, Washington, D. C.

WILBUR A. DEXHEIMER, M. ASCE, Commissioner, Bur. of Reclamation, Dept. of Int., Washington, D. C.

E. R. DE LUCCIA, M. ASCE, Vice-Pres. and Chief Engineer, Pacific Light & Power Co., Portland, Ore.

4:20 Discussion

5:00 Adjournment

CONVENTION PARTY

Wednesday, June 6

7:30 p.m. Volunteer Ballroom, Univ. Center

7:30 to 8:30—Dinner

8:30 to 9:00—Entertainment

9:00 to 11:00—Smoky Mountain Square Dancing

All members and their ladies are urged to attend this informal dinner and square dance. A leading East Tennessee square dance orchestra will provide the music while a group of costumed "hillbillies" will demonstrate how the dances should be performed. Lack of technique in square dancing know-how need stop no one from attendance. One of the region's most famous square dance callers, T. W. Kleinsasser, will be in charge of the evening's activities. Comfortable clothing and low heels are a "must."

Per plate, $3.50. Tickets for this event must be purchased before noon on Wednesday.

THURSDAY MORNING

JUNE 7

Power Division

9:00 a.m. Grille, Univ. Center

Presiding: R. E. Glover, M. ASCE, Research Engineer, U. S. Bureau of Reclamation, Denver, Colo.

9:00 The Philosophy of Arch Dams

A. COYNE, HON. M. ASCE, Consulting Engineer, Paris, France.

The Development of Arch Dams in Italy

CARLO SEMENZA, M. ASCE, Manager of Hydraulic Construction, Societa Adriatica de Elettricita, Venice, Italy.

Methods of Calculation and Model Confirmations

GUIDO OBERTI, M. ASCE, Director, Institute Sperimentale Modelli e Strutture, Bergamo, Italy.

DINO TONINI, M. ASCE, Director of Studies, Societa Adriatica de Elettricita, Venice, Italy.

Engineering Mechanics and Hydraulics Divisions—Joint Session

9:30 a.m. Room 104, Law Bldg.

Presiding: Victor L. Streeter, M. ASCE, Research Prof., Illinois Inst. of Tech., Chicago, Ill.; Carl E. Kindsvater, M. ASCE, Executive Committee, Hydraulics Division

9:30 Mechanics of Sediment Ripple Formation

H. K. LIU, Asst. Prof. of Civil Eng., Colorado A. & M. College, Fort Collins, Colo.

9:55 Discussion

10:05 Analysis of Flow in Lock Systems

JOHN S. MCNOWN, M. ASCE, Prof., Eng. Mech. Dept., Univ. of Michigan, Ann Arbor, Mich.

10:30 Discussion

10:40 Submerged Sluice-Gate Control of Density Currents

DONALD R. F. HARLEMAN, J.M. ASCE, Asst. Prof. of Hydraulics, Mass. Inst. of Tech., Cambridge.

ROBERT S. GOOCH, J.M. ASCE, Freese & Nichols, Fort Worth, Tex.

ARTHUR T. IPPEN, M. ASCE, Prof. of Hydraulics, Mass. Inst. of Tech., Cambridge, Mass.

Sanitary Engineering Division

9:30 a.m. Moot Court, Law Building

Presiding: Roy J. Morton, Chairman, Executive Committee, Sanitary Engineering Division; Alfred Rudnick, J.M. ASCE, Research Asst., Case Inst. of Tech., Cleveland, Ohio

9:30 Introductory remarks

ROY J. MORTON, M. ASCE, Leader, Radioactive Waste Research, Health Physics Div., Oak Ridge National Labs., Oak Ridge, Tenn.

9:40 Radioactive Sediments in Tennessee River System

J. M. GARNER, Health Physicist, Oak Ridge National Labs.

OSCAR W. KOCHTITZKY, A.M. ASCE, Public Health Officer, Division of Health and Safety, TVA, Chattanooga, Tenn.

10:10 Discussion

10:20 Muncipal Ordinances for Industrial Wastes

JULIAN R. FLEMING, M. ASCE, Director, Div. of San. Eng., State Dept. of Health, Nashville, Tenn.

10:50 Discussion

11:05 Knoxville Sewage Treatment Plant

KENNETH V. HILL, M. ASCE, Greeley & Hansen, Consulting Engineers, Chicago, Ill.

11:50 Discussion

Highway, Surveying and Mapping Divisions—Joint Session

9:30 a.m. Room 233, Business Admin. Bldg.

Presiding: B. E. Beavin, M. ASCE, Chairman, Executive Committee, Surveying and Mapping Division

9:30 Field Control of Earthwork Construction

PAUL J. GARBER, A.M. ASCE, Soils Engineer, Howard, Needles, Tammen & Bergendoff, Kansas City, Mo.

9:50 Developing Simultaneously an Aerial Map for Highway Design and Geological and Soil Interpretation

T. L. COLLINS, President, Maps, Inc., Baltimore, Md.

Panel Discussion—Surveying and Mapping for Modern Highways

Moderator: W. N. Calvert, Jr., M. ASCE, Civil Engineer, TVA, Knoxville, Tenn.

10:10 Uses of Aerial Surveying in Highway Location and Design

D. K. BLYTHE, A.M. ASCE, Asst. Prof. of Civil Eng., Univ. of Kentucky, Lexington, Ky.

10:25 Basic Control of Highway Mapping

CAPT. CHARLES PIERCE, M. ASCE, Chief, Div. of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

10:40 What Aerial Mappers Can Contribute to Highway Planning and Location

J. G. LADD, Col., USA (ret.) Executive Secretary, Assoc. of Professional Photogrammetrists.

10:55 Bureau of Public Roads Experience on Highway Surveys

W. T. PRYOR, A.M. ASCE, Highway Engineer, Bureau of Public Roads, Washington, D. C.

11:10 General discussion

Structural Division

9:15 a.m. Room 135, Business Admin. Bldg.

Presiding: Leo H. Corning, Member, Executive Committee, Structural Division

Session on Ultimate Strength Design

9:15 Confirmation of Inelastic Stress Distribution in Concrete

EIVIND HOGNESTAD, A.M. ASCE, Manager, Structural Div., Portland Cement Assoc. Chicago, Ill.

9:55 Interpretation of Recommendations for Ultimate-Strength Design as Related to Present Practice

RAYMOND C. REESE, M. ASCE, Consulting Engineer, Toledo, Ohio.

10:35 Simplification of Design by Ultimate-Strength Procedures

PHIL M. FERGUSON, M. ASCE, Prof. and Chairman, Dept. of Civ. Eng., Univ. of Texas, Austin, Tex.

11:15 Application and Practical Advantages of Ultimate-Strength Design

CHARLES S. WHITNEY, M. ASCE, Partner, Ammann & Whitney, Consulting Engineers, Milwaukee, Wis.

MEMBERSHIP LUNCHEON

Thursday, June 7

12:15 p.m. Volunteer Ballroom, Univ. Center

Presiding: Graham P. Willoughby, Director, District 10, ASCE

Speaker: ENOCH R. NEEDLES, President of ASCE

Subject: Where Are We Going?

All members and guests, and friends of ASCE are cordially invited.

Per plate, $2.50. Tickets for this event must be purchased before 5:00 p.m., Wednesday.

THURSDAY AFTERNOON

JUNE 7

Power Division

2:15 p.m. Grille, Univ. Center

Presiding: Robert A. Sutherland, Chairman, Executive Committee, Power Division

Design and Observation of Arch Dams in Portugal

2:15 Improvements in Design Through Model Tests

J. LAGINHA SERAPIM, A.M. ASCE, Asst. Research Engineer, Laboratorio National de Engenharia Civil, Lisbon, Portugal.

Observed Structural Behavior

A. F. DA SILVEIRA, Laboratorio National de Engenharia Civil, Lisbon, Portugal.

New Trends in Experimental Studies of Dams

MANUEL ROCHA, M. ASCE, Laboratorio National de Engenharia Civil, Lisbon, Portugal.

Trial Load Studies for Hungry Horse Dam

R. E. GLOVER, M. ASCE, Research Engineer; and MERLIN D. COPEN, Concrete Dams Section; U. S. Bureau of Reclamation, Denver, Colo.

Review of Experience—A compilation

Construction Division

2:15 p.m. Room 233, Business Admin. Bldg.

Presiding: Alexander Brest, Member, Executive Committee, Construction Division

2:15 Industrialization of the South

DR. FRANK SODAY, Vice Pres. and Director of Research, Chemstrand Corp., Decatur, Ala.; President, Southern Association of Science and Industry.

3:15 Development of Chemical Industry in the South

W. J. RAVE, Magnesium Products Manager, Dow Chemical Corp., Freeport, Tex.

Sanitary Engineering Division

2:15 p.m. Moot Court, Law Bldg.

Presiding: Richard King, A.M. ASCE, Prof. of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.; Morton I. Goldman, J.M. ASCE, Sanitary Engineer, Public Health Service, on assignment at Oak Ridge National Labs., Oak Ridge, Tenn.

2:15 Sanitary Engineering Research—Role of Research Grants

HARRY FABER, Research Coordinator, Office of Eng. Resources, U. S. Public Health Service, Washington, D. C.

2:45 Discussion

2:55 Effects of Tributary Storage Impoundments on Water Quality

MILO A. CHURCHILL, A.M. ASCE, Public Health Engineer, TVA, Chattanooga, Tenn.

3:25 Discussion

3:35 Preliminary Studies on Complete Anaerobic Sewage Treatment

JAMES B. COULTER, Sanitary Engineer; SHINJI SONEDA, J.M. ASCE; M. B. ETTINGER, Chief, Physics and Chemistry Section; Water Supply and Water Pollution Control, Public Health Service, Cincinnati, Ohio.

4:05 Discussion

4:15 A Mathematical Approach Toward Flotation

ROBERT H. L. HOWE, Eli Lilly and Co., Lafayette, Ind.

4:40 Studies on Solid-Liquid Separation of Activated Sludge by Dissolved Air Flotation

W. WESLEY ECKENFELDER, A.M. ASCE, Asst. Prof., Dept. of Civil Eng., Manhattan College, New York, N. Y.; THOMAS ROONEY and JAMES FARRELL, members of ASCE Student Chapter, Manhattan Col.

5:05 Discussion

Hydraulics Division

2:15 p.m. **Room 104, Law Bldg.**

Presiding: Carl E. Kindsvater, Member, Executive Committee, Hydraulics Division

Session on Hydraulic Design

2:15 Introductory remarks

DON H. MATTERN, M. ASCE, Member, Hydraulic Design Committee, Hydraulics Division.

2:20 A Design for Thermal Density Underflow Diversion

REX A. ELDER, M. ASCE, Head, Hydraulic Lab.; GALE B. DOUGHERTY, A.M. ASCE, Head, Hydraulic Structures Unit, Hydraulic Lab.; TVA, Norris, Tenn.

3:05 Field Tests on TVA's Hiwassee Pump-Turbine

LESLIE J. HOOPER, M. ASCE, Director of Alden Hydraulic Lab., Worcester Polytechnic Inst., Worcester, Mass.

HYDRAULICS DIVISION DINNER

Thursday, June 7

5:45 p.m. **Volunteer Ballroom, Univ. Center**

Presiding: Joseph B. Tiffany, Chairman, Executive Committee, Hydraulics Division

All Division members, members' guests, and friends of ASCE are cordially invited.

The dinner will be over in time to attend the Carousel Performance.

Per Plate, $2.50. Tickets for this event must be purchased before noon on Thursday.

Soil Mechanics and Foundations Division

2:15 p.m. **Room 103, Law Bldg.**

Presiding: Ralph E. Fadum, M. ASCE, Head, Dept. of Civil Eng., N. C. State College, Raleigh, N. C.

2:15 Moisture Conditions Under Flexible Airfield Pavements

J. F. REDUS, JR., A.M. ASCE, Engineer, Flexible Pavement Branch, Waterways Experiment Sta., Vicksburg, Miss.

2:45 Discussion

3:00 Statistical Analyses of Base-Course Specifications

F. H. KELLOGG, M. ASCE, Dean of Engineering, Univ. of Miss., University, Miss.

3:30 Discussion

3:45 Investigation of Effect of Repetitive Loading on Compacted Cohesive Soil

DEAN R. FREITAG, J.M. ASCE, Chief, Soil Stabilization Section, Waterways Experiment Sta., Vicksburg, Miss.

4:15 Discussion

Structural Division

2:15 p.m. **Room 135, Business Admin. Bldg.**

Presiding: R. F. Blanks, Chairman, Committee on Masonry and Reinforced Concrete, Structural Division

Session on Shell Structures

2:15 Physical Behavior of Shells

W. WORTHINGTON EWELL, A.M. ASCE, Consulting Engineer, Baltimore, Md.

2:55 Economic Considerations in Design and Construction of Shells

BOYD G. ANDERSON, Associate Partner, Ammann and Whitney, Consulting Engineers, New York, N. Y.

3:35 Ribless Shells

ANTON TEDESKO, M. ASCE, Manager, Roberts and Schaefer Co., New York, N. Y.

4:15 Hyperbolic-Paraboloids and Other Shells of Double Curvature

ALFRED L. PARME, A.M. ASCE, Structural and Railways Bureau, Portland Cement Assoc., Chicago, Ill.

THURSDAY EVENING

JUNE 7

Entertainment Available

8:30 p.m., Carousel Theater, 17th St., between Rose & Yale Aves.

Broadway plays were never more enjoyable than in the Carousel Theater. This arena theater is jointly sponsored by the University of Tennessee and the community. It is located just three blocks from the Convention headquarters at the University Center.

Visitors to the Convention will be privileged to see a pre-season performance of the first play in the 1956 summer series, being shown exclusively for them. The play is being selected for the enjoyment of all members of a family.

Per person, $1.50. Capacity of the theater is 420, so the tickets will be sold on a first-come basis.

FRIDAY MORNING

JUNE 8

Power Division

9:00 a.m. **Grille, Univ. Center**

Presiding: Alfred L. Parme, A.M. ASCE, Portland Cement Assoc., Chicago, Ill.

9:00 Theory, Methods and Details of Grouting Contraction Joints in Arch Dams

A. W. SIMONDS, M. ASCE, Concrete Dams Section, U. S. Bureau of Reclamation, Denver, Colo.

Economics of Dams

L. G. PULS, A.M. ASCE, Head, Concrete Dams Section, U. S. Bureau of Reclamation, Denver, Colo.

Review of Experience—A Compilation

Construction Division

9:30 a.m. **Room 233, Business Admin. Bldg.**

Presiding: Alexander Brest, Member, Executive Committee, Construction Division

9:30 Economic Impact of the Pulp and Paper Industry on the South

J. W. MCSWINEY, Executive Vice President, Mead Corp., Dayton, Ohio

10:30 Paper Mill Basic Design, General Construction and Operation

G. W. REYNOLDS, Chief Engineer, Mead Corp. and Rome Products Co.

Hydraulics Division

9:00 a.m. **Room 104, Law Bldg.**

Presiding: Albert S. Fry, M. ASCE, Chief, Hydraulic Data Branch, TVA

Hydrology Session

9:00 Economic Use of Agricultural Resources in Relation to Watershed Hydrology

EDWARD H. LESESNE, A.M. ASCE, Hydrologist, TVA, Asheville, N. C. DR. A. J. COUTU, Agricultural Economist, N. C. State College, Raleigh, N. C.

9:30 Discussion

9:45 VHF Automatic Radio Gage System for Reporting Hydrologic Data

JAMES A. DALE, Electrical Engineer, TVA.

10:05 Discussion

10:15 Water Dispatching in TVA Reservoir System

J. H. WILKINSON, M. ASCE; ALFRED BLICKENSDERFER, A.M.

ASCE; and LE ROY ENGSTROM; Hydraulic Engineers, TVA, Knoxville, Tenn.

10:35 Discussion

10:45 Measurement of Sedimentation in TVA Reservoirs

E. H. MCCAIN, A.M. ASCE, Sedimentation Specialist, TVA, Knoxville, Tenn.

11:05 Discussion

Sanitary Engineering Division

9:30 a.m. Moot Court, Law Building

Presiding: Conrad P. Straub, A.M. ASCE, Senior Sanitary Engineer, U. S. Public Health Service; on assignment, Oak Ridge National Labs., Oak Ridge, Tenn.

9:30 Panel Discussion—Sanitary Engineering Education

Moderator: HARVEY F. LUDWIG, M. ASCE, Chief, Office of Engineering Resources, Public Health Service, Washington, D. C.

ERMAN A. PEARSON, A.M. ASCE, Asst. Prof., Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

RAY E. LAWRENCE, M. ASCE, Black & Veatch, Kansas City, Mo.

ROBERT E. STIEMKE, M. ASCE, Director, School of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.

ADOLPH J. ACKERMAN, M. ASCE, Consulting Hydroelectric Engineer; Chairman, Task Committee on Engineering Education, Madison, Wis.

11:30 Discussion

Soil Mechanics and Foundations Division

9:30 a.m. Room 103, Law Bldg.

Presiding: Stanley Johnson, Moran, Proctor, Mueser and Rutledge, New York, N. Y.

9:30 Building Foundations in the Appalachian Region

GEORGE F. SOWERS, A.M. ASCE, Prof., Dept. of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.

10:00 Discussion

10:15 Some Factors Influencing the Performance of Earth Dams

JAMES L. SHERARD, A.M. ASCE, Partner, Woodward, Clyde, & Associates, Denver, Colo.

10:45 Discussion

11:00 Research on the Consolidation of Clays

GERALD A. LEONARDS, A.M. ASCE, Assoc. Prof. of Soil Mech., Purdue Univ. Lafayette, Ind.

11:30 Discussion

Structural Division

9:15 a.m. Room 135, Business Admin. Bldg.

Presiding: Ernest C. Hartmann, Chairman, Executive Committee, Structural Division

Session on Prestressed Concrete

9:15 Selection of Factors in Criteria for Prestressed Concrete Bridges, Bureau of Public Roads

E. L. ERICKSON, Chief of Bridge Branch, Bureau of Public Roads, Washington, D. C.

9:55 Cable Friction in Post-Tensioning

T. Y. LIN, M. ASCE, Prof., Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

10:35 Ultimate Shear Resistance of Prestressed Beams

EUGENE MILTON ZWOYER, J.M. ASCE, Dept. of Civil Eng., Univ. of New Mexico, Albuquerque, N. Mex.

11:15 Ultimate Capacity of Continuous Prestressed Members

JEAN MULLER, Société Technique Pour L'Utilisation de la Précontrainte, Paris, France.

PLANNED TOURS

Friday Afternoon, June 8

Special buses will leave the University Center at 1:00 p.m., Friday and return by 6:00 p.m. Tickets should be obtained at the time of registration.

Kingston Steam Plant

Kingston Steam Plant, built and operated by TVA, is the world's largest steam-electric station. Its nine units have a capability of 1,600,000 kw and burn some 12,000 tons of coal a day. It is located on the Clinch River about 40 miles from Knoxville. Per person, $1.50.

Oak Ridge National Laboratory and Museum of Atomic Energy

The original graphite reactor, the "swimming pool" reactor, the high-voltage laboratory, and the packaging of isotopes will be seen at the Oak Ridge National Laboratory. The tour through the museum will give a thumb-nail sketch of principles and developments in the field of nuclear physics.

Trip is limited to 160 persons; each must be an ASCE member and an American citizen. Per person, $2.00.

City of Oak Ridge and Museum of Atomic Energy

This trip is primarily for the ladies and others who cannot be admitted to the Laboratory. It will include a trip to the Museum and a special bus tour of the city of Oak Ridge, built and operated by the Government for those who constructed and those who operate the atomic plants. Per person, $2.00.

Norris Dam and TVA Hydraulic Laboratory

Norris Dam, the first dam constructed by TVA, has always been a focal point for visitors. It is a concrete structure 265 ft high located on the Clinch River 26 miles from Knoxville. The two generating units have a combined capacity of 100,000 kw. The TVA Hydraulic Laboratory, located in the nearby town of Norris, will be inspected. Under test will be a large-scale (1:16) hydraulic model of the proposed new navigation lock at Wilson Dam with a lift of 100 ft, the highest in the world. Per person, $1.00.

Saturday Tour of Dams, June 9

This trip is planned primarily for those who attend the Symposium on Arch Dams. Private cars will be used, leaving the University Center at 8:00 a.m. Saturday and returning about 6:00 p.m.

Visitors will drive into the Great Smokies along the Little Tennessee River and inspect Chilhowee Dam (under construction), Calderwood Dam and powerhouse, and Cheoah Dam, all built by the Aluminum Company of America. The trip will also include an inspection of TVA's Fontana Dam, the highest (480 ft) east of the Mississippi, and a visit to Fontana Village, the former construction camp now operated as a resort.

Lunch will be obtained either at Fontana Village or Tapoco Lodge, of the Aluminum Company of America.

LADIES PROGRAM

Monday, June 4

12:30 a.m. Johnson Hall, Hotel Andrew Johnson

Luncheon. The luncheon will be followed by a drive to Holston Hills, one of the finer residential areas, and a visit to Blount Mansion, home of the first governor of Tennessee.

Tuesday, June 5

2:00 to 4:00 p.m. Game Room, Univ. Center

Bridge and Canasta Party

Wednesday, June 6

9:15 to 9:45 a.m. Grille, Univ. Center

General Session. Ladies are invited to join their husbands at the General Session which officially opens the Convention.

12:15 p.m. Volunteer Ballroom, Univ. Center

General Luncheon. The ladies are cordially invited to attend the General Luncheon. Per plate $2.50.

2:30 p.m. Drive and Tea

Drive through residential areas in West Knoxville, followed by a visit to the Eunice Miller Antique Shop. Tea will be served, courtesy of the Tennessee Valley Section.

Thursday, June 7

9:15 a.m. All-Day Trip

An all-day trip to the Great Smoky Mountains National Park will include luncheon at the Mountain View Hotel at Gatlinburg, together with an opportunity to visit the Craft Shops.

Buses will leave the University Center promptly at 9:15 a.m. and will return about 5:00 p.m. Per person, $4.00.

Friday, June 8

9:30 a.m. Rich's, Inc.

A Brunch and Style Show will be held at Rich's, Inc., located within easy walking distance of the downtown hotels. The free Convention buses will go by Rich's both going to and coming from the University Center. Per person, $1.00.

LADIES HOSPITALITY ROOMS

Saturday through Monday, June 2–4, Carousel Room, Hotel Andrew Johnson

Tuesday through Thursday, June 5–7, University Center

The Hospitality Rooms will be the gathering places for all ladies who attend the Convention. Hostesses will be there daily from 9:00 to 5:00 p.m. Coffee will be served from 9:00 a.m. to 11:00 a.m. on Monday and Wednesday, and tea will be served Tuesday from 3:00 p.m. to 4:00 p.m.

INFORMATION AND REGISTRATION

Information and registration facilities will be maintained in the Upper Lobby of the Hotel Andrew Johnson from Sunday, June 3, through Monday, June 4. These facilities will be available in the First Floor Lobby of the University Center from Tuesday, June 5, through Friday, June 8. Mail and messages will be held for members at the Information Desk.

CONVENTION OFFICE AND PRESS ROOM

June 1-4, Parlor B, Hotel Andrew Johnson
June 5-8, Room 116, University Center

For the coordination of Convention operations, a business office will be maintained and press facilities will be available throughout the days preceding and during the Convention.

HOTEL ACCOMMODATIONS

Headquarters for the first two days of the Knoxville Convention, June 3 and 4, will be at the Hotel Andrew Johnson, 914 South Gay Street. On Tuesday, June 5, the headquarters will be moved to the University Center on the campus of the University of Tennessee, located about ten blocks west of Gay Street.

Starting Tuesday morning, June 5, special buses will provide free transportation for Convention visitors between the downtown hotels and the University Center. Buses will operate daily between the hours of 7:30 a.m. and 9:30 a.m., and 4:00 p.m. and 6:00 p.m., and as required for evening entertainments Wednesday and Thursday. City transportation services also are available throughout the day.

Arrangements have been made to accommodate Convention visitors at the hotel headquarters and nearby hotels in the order that reservation requests are received.

For your convenience, a special request form is provided on page 136 of this issue.

Send your request as early as possible in order to assure the accommodations you prefer. Late requests may be assigned to other hotels. Your request should be mailed directly to the hotel of your choice. See list of hotels and their rates on page 136. Confirmation of your reservation will be made to you by the hotel.

DORMITORY FACILITIES

For the convenience of male visitors to the Convention, West Hall, a new and modern dormitory located on the University of Tennessee campus two short blocks west of the University Center, has been made available. West Hall has 200 attractively furnished twin bedrooms that will accommodate 400 men. Adequate telephone facilities, comfortable lounges, and a post office are provided. Dry cleaning and laundry facilities are conveniently located nearby as well as restaurants and a cafeteria. The nightly rate is $3.50 per person.

Requests for reservations in West Hall should be addressed to: BRUCE E. HARRISON, Turner House, University of Tennessee, Knoxville, Tenn.

STUDENT MEMBER ACCOMMODATIONS

A limited number of rooms for student members have been made available at the Knoxville YMCA. The rooms are twin bedrooms, accommodating two students, at a special rate of $1.50 per student per night. The YMCA is conveniently located for those attending the Convention. Requests should be mailed early to assure accommodations to: JOHN S. KENNEDY, Knoxville YMCA, 605 West Clinch Ave., Knoxville, Tenn.

A WORD ON THE WEATHER

June in Knoxville is warm. Summer clothes, with a lightweight topcoat for the mountains, will be appropriate.

KNOXVILLE CONVENTION GENERAL COMMITTEE

DON H. MATTERN, *General Chairman*
Ernest M. Titus, *Secretary-Treasurer*

Advisory Committee
Nathan W. Dougherty
Albert B. Goodwin
Roy J. Morton
John L. Neely, Jr.
George P. Palo
James Smallshaw
Lewis A. Schmidt, Jr.
John C. Voorhees
Harry A. Wiersema

Arrangements
Henry B. Aikin, *Chairman*

Entertainment
Nathan E. Way, *Chairman*

Exhibits
Harry B. Tour, *Chairman*

Field Trips
Wylie A. Bowmaster, *Chairman*

Finance
William F. Moehlman, *Chairman*

Hospitality
James E. Goddard, *Chairman*

Housing
Robert C. Burns, *Chairman*

Program
Albert S. Fry, *Chairman*

Publicity
Alfred J. Cooper, *Chairman*

Registration
Robert H. Nagel, *Chairman*

Transportation
Reed A. Elliot, *Chairman*

Technical Program
Gale B. Dougherty, *Chairman*

Ladies Committee
Mrs. C. E. Blee, *Chairman*

SOCIETY NEWS

Local Sections Support ASCE Highway Resolution

A number of the Local Sections have already responded to President Needles' plea to support the recent resolution of the Board of Direction to Congress urging enactment of legislation for an expanded long-range highway program. At the request of the Society's Task Committee on National Highway Program and the Highway Division, President Needles has circularized the Sections and Branches calling attention to the tremendous importance of an adequate highway construction program to the nation's economy and asking their help in obtaining such a program. At his suggestion, many of the Sections and Branches have devoted either a regular or special meeting to the vital subject.

The Society's resolution to the members of the Public Works Committee of the U. S. Senate and House of Representatives reads as follows:

WHEREAS, The highway system of the United States has become increasingly vital to commerce, industry, agriculture and mining, with more than one-seventh of the nation's gainfully employed population engaged in highway transportation;

WHEREAS, An adequate highway system is vital to the national defense;

WHEREAS, Highway inadequacies constitute a serious problem in the lives of our citizens, hampering transportation and bringing choking congestion to our towns and cities;

WHEREAS, These inadequacies are a prime contributing cause of traffic accidents with their toll of deaths, blighted lives and property loss;

WHEREAS, The highway network is now serving 61,300,000 registered vehicles compared with 30,000,000 in 1946, with little or no increase in highway mileage and relatively little net improvement in highway conditions;

WHEREAS, Because of mounting traffic volume with consequent increased wear and tear on existing roads, and with long-range growth inevitable, time presses urgently;

WHEREAS, The present highway construction level throughout the nation clearly has been proven inadequate in general for making significant reductions in the accumulated highway deficiencies;

WHEREAS, Authoritative data on highway needs and costs are available, as a basis for devising sound federal legislation in the public interest;

WHEREAS, With increasing traffic on all highways, the National System of Interstate Highways has emerged as the key network, carrying some 14 percent of all highway traffic on $1^1/_2$ percent of the highway mileage, and interconnecting the various regions and principal cities;

AND WHEREAS, While hitherto the states from their limited funds have contributed to the National System of Interstate Highways included in their highway networks, the possibility of greatly increased Federal participation both in amount and on a proportionate basis has created a state of indecision delaying further construction on this system;

BE IT THEREFORE RESOLVED by the American Society of Civil Engineers, in convention assembled in New York City on this 27th day of October 1955,

That the Congress of the United States enact legislation for an expanded long-range highway program, including provision for the complete construction of the National System of Interstate Highways in a period not to exceed fifteen years;

That, in determining the details of this program and its financing, the problem be weighed in terms of the broad public interest, without regard to partisanship or self-seeking special interests, but rather boldly and with the knowledge that a direct and far-seeing approach is vital if a fair and equitable solution is to be found in the interest of all.

That a definite program of financing be enacted to permit orderly advance planning, preparation of necessary rights of way and construction;

That financing be on such a basis that complete rather than disconnected segments of needed new facilities can be brought to active construction and completion quickly, in order to provide the full benefit of efficient transportation;

That on determining the federal highway program, special emphasis be given to the necessity of developing the National System of Interstate Highways to the highest engineering standards with full control of access to insure utmost transportation efficiency;

AND BE IT FURTHER RESOLVED, That copies of this resolution be supplied to the members of the Committees of Public Works respectively of the Senate and House of Representatives of the Congress of the United States.

Annual Business Meeting To Be Held in Pittsburgh

Except as the Board states otherwise, the Society's Annual Business Meeting must be held in New York City, and it has customarily been a feature of the Annual Convention. With the 1956 Annual Convention slated for Pittsburgh, the Board has taken necessary action to permit holding the meeting in that city in October during the Pittsburgh Convention. The date of the Annual Business Meeting will be Wednesday morning, October 17.

W. M. Wilson Honored By Research Council

Wilbur M. Wilson (right), Hon. M. ASCE and research professor of structural engineering at the University of Illinois, receives honorary plaque from Research Council on Riveted and Bolted Structural Joints for his long service on the Council. Presentation of the bronze plaque was made on February 9 by T. R. Higgins, of the American Institute of Steel Construction, who was first chairman of the Council. The plaque will be hung in the Talbot Library at the University of Illinois.

An Improper Use of the Society's Name

A firm of engineers, which had previously assisted a city by designing and supervising construction of a municipal facility, was engaged subsequently to recommend plans for improving and enlarging the facility. During a political campaign the proposed municipal improvement became an issue, and numerous notices appeared in the local newspapers reflecting on the professional reputation of the firm and its recommendations to the city. The administration of the city changed; the firm's contract was cancelled; and the newspapers supported editorially an alternate plan prepared by employees of the city.

In defense of its reputation and as a public service, the firm several months later purchased a full-page advertisement in the community's newspapers presenting factual statements about their plan. The propriety of an advertisement for the purpose proposed was discussed by letter with the Executive Secretary and the President of the Society. They agreed in personal opinion that the purchase of newspaper space to present factual information to the public would not violate the intent of the "advertising clause" in the Code of Ethics.

When published, the newspaper page contained a foreword stating that the ethics of resorting to a public notice to protect the firm's professional reputation had been "justified" by the Executive Secretary and the President of ASCE. At its meeting in Dallas the Board of Direction concluded that such use of the Society's name in a local controversy in which the Society has no direct interest is not permissible. In ruling that it is improper for the name of the Society to be brought into any such local controversy in any manner or for any reason, the Board directed that this statement be published for the information of the membership.

EJC Compiles Directory of Engineering Societies

A complete list of all engineering societies in the United States, together with pertinent information about them, will be published by Engineers Joint Council this summer under the title of *The Engineering Societies Directory*. The directory will be a new publication—not a revision of the Engineering Societies Yearbook, which has been discontinued. It will be the only complete listing of engineering societies at all levels, and will be available at a prepublication price of $3.50 a copy.

Questionnaires have been mailed to all known societies. Any society that has not received such a questionnaire should get in touch at once with Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

Structural Division to Aid In Earthquake Conference

The ASCE Structural Division will be one of the cooperating groups in the World Conference on Earthquake Engineering, to be held at Berkeley, Calif., June 12–16. This highly important conference is being set up by the Earthquake Research Institute and the University of California, with the cooperation of the Structural Division and the Structural Engineers Association of California.

Named to Task Force On Water Measurements

In the Society's Official Register for 1956 two names were omitted from the Task Force on Water Measurements under the Hydraulics Division's Committee on Design. They are Prof. Andre L. Jorissen and Prof. Chilton A. Wright. Ernest T. Schuleen is chairman of the Task Force, which also includes John Casey and Kenneth W. Kirkpatrick.

How to Order ASCE Membership Listing

To make it easier for members to order the biennial Directory of Membership, a return postcard will be sent out to all members early in June. This decision of the Board of Direction, at its Dallas meeting, supersedes earlier plans to handle ordering by means of a coupon in CIVIL ENGINEERING. The 1956 Membership Directory will be ready this summer.

June 1955 Issue Is Out of Stock

The June 1955 issue of CIVIL ENGINEERING is out of stock. It will be greatly appreciated if members not wishing to bind their back copies will send in their copies of that issue for the benefit of those who do want to do so. Copies may be addressed to the Editor of CIVIL ENGINEERING.

ASCE MEMBERSHIP AS OF MARCH 9, 1956

Members	9,127
Associate Members	11,756
Junior Members	17,699
Affiliates	72
Honorary Members	41
Total	38,695
(March 9, 1955	38,169)

Waterways Division Changes Its Name

The name of the Waterways Division has been changed to the Waterways and Harbors Division. This change has been authorized by the Board of Direction at the request of the Division. Charles M. Wellons is chairman of the executive committee of the Division.

New Award Honors Thomas Middlebrooks

A new ASCE award, established by the Society in 1955 in honor of the late Thomas A. Middlebrooks, will be given for the first time this fall. As announced in the 1956 Official Register, candidates for the award will be recommended to the Board of Direction by the Soil Mechanics and Foundations Division. The award will go to the author or authors of papers, published in the current TRANSACTIONS, considered an especially meritorious contribution to soil mechanics and foundation engineering. Preference will be given to a paper by a young engineer.

Mr. Middlebrooks was an outstanding authority on soil mechanics and active on the Soil Mechanics and Foundations Division's Committee on Earth Dams. During his lifetime he served as a consultant on several large earth dams in foreign countries, and it was during a trip to Central Africa as a consultant that he contracted the malaria known as "flat water fever," which resulted in his death on February 3, 1954.

The Thomas A. Middlebrooks Award consists of a cash prize of $100, with the successful candidate given the option of receiving books of his own selection in lieu of cash. A certificate signed by the President and the Secretary of the Society and suitable book-plates for the books are a feature of the award.

T. A. Middlebrooks

Knoxville Convention Preview

Knoxville Convention plans, in the making for many months, are furthered at committee meeting in Knoxville. Pictured, in usual order, are Don P. Reynolds, assistant to the Executive Secretary; Don H. Mattern, general Convention chairman; George P. Palo president of the host (Tennessee Valley) Section; and Ernest M. Titus, general secretary-treasurer of Convention Committee. Photo courtesy of "Knoxville Journal."

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

There has been a change in the **Akron Section's** official panel. Myron S. Raudebaugh, Jr., elected secretary-treasurer for 1956, finds himself unable to serve and is being succeeded by Ray Seese. The Section's March meeting featured a talk by local consultant Francis W. Stafford on industrial water supply.

A report on the Cooper Lake Hydroelectric Power Project prepared for the Central Alaska Power Association was discussed at the February meeting of the **Alaska Section's Anchorage Branch** by Ivan Block, Robert E. Retherford, and Carl H. Steeby, all with North Pacific Consultants. Located in the most difficult terrain of the Kenai Peninsula, the project will involve construction of a small earthfill dam and a two-mile-long tunnel through a ridge. It will supply energy for a 10,000-sq mile area where the demand for electrical energy already exceeds available generation capacity. New Branch officers are Wesley H. Butler, president; Daniel J. Dougherty, vice-president; and Calvin M. Winey, Jr., secretary-treasurer. All live in Anchorage.

At the helm for 1956 in the **Central Ohio Section** are Thomas W. Singell, president; Charles B. Smith, first vice-president; Roy T. Underwood, second vice-president; and Robert W. Duis, secretary-treasurer.

Students from the ASCE Chapter at the University of Cincinnati were the speakers at the annual joint meeting of the **Cincinnati Section** and the Chapter in February. William Gates and Angelo Santoro discussed the Mackinac Straits Bridge, and Franklin Munstock described the construction of the Cincinnati Gas and Electric Company's new gas supply line. At the March meeting Harry P. Kramer, chief of the Training Program at the Robert A. Taft Sanitary Engineering Center of the U. S. Public Health Service, spoke on the complex water supply and pollution problems arising from the tremendous increase in population and industry, and showed slides describing current research activity directed toward the solution of these problems. New Section officers, elected at the March meeting, are Cornelius Wandmacher, president; Ray Raneri, vice-president; and Robert H.

H. A. R. Austin, Honolulu engineer, receives Life Membership Certificate from Francis Wai, incoming president of Hawaii Section, at recent Section meeting. Outgoing President William Wachter (left) and Frederick Ohrt (right) are the others in the picture. New Section officers, in addition to Mr. Wai, are Donald Austin, vice-president; Franklin Sunn, secretary; and Edward Morgan, treasurer.

Some of 189 members and guests of Mid-Missouri Section and Missouri School of Mines Student Chapter at recent joint banquet honoring President Enoch R. Needles are (reading left to right) Prof. Leon Hershkowitz, Faculty Adviser for Missouri School of Mines Chapter; Richard Johnson, junior director of the Section; Section President Daniel Kennedy; President Needles; Prof. E. W. Carlton, ASCE Director for District 14; Adrian Pauw, vice-president of Section; and Samuel Rudder, secretary-treasurer of Section.

Akers, secretary-treasurer. They will take office in May.

The special importance of pollution control in highly populated and industrialized Ohio was also stressed in the **Cleveland Section's** February program. George A. Hall, engineer-secretary of the State Water Pollution Control Board, discussed progress made in sewage treatment since 1952 when the Water Pollution Control Act went into effect and described the mobile trailer laboratories the Board uses for on-the-spot study of treatment requirements. By 1960 the Board will have accomplished 90 percent of its objectives, he believes.

Duluth's school construction program was described at the February 20th meeting of the **Duluth Section.** A. J. Ward, chief engineer of the school system, was featured speaker. Heard at recent meetings of the **Iron Range Branch** were a Minnesota Highway Department representative, who commented on the Federal Highway Program, and a speaker on aviation, with special reference to its demand for personnel from engineering and the associated professions.

The **Palm Beach Branch** of the **Florida Section** elected 1956 officers at a meeting in February—J. H. Langford, president; Roy E. Weber, vice-president; and Alan L. Craig, secretary-treasurer. Honored at the same meeting were new Life Members Rudolf P. Forsberg and George B. Davidson.

The **Georgia Section** and Atlanta Post of the Society of American Military Engineers were co-sponsors of a meeting in March. Featured speaker was Col. Robert R. Conner, of the U. S. Air Force, who dealt with the problems created by the frequent changes in techniques and materials common in the Air Force. The aims of Engineers' Week were well put across in Augusta, headquarters of the Section's **Central Savannah River Valley Branch,** which cooperated with the other societies in the area in presenting engineering in a good light to high schools and civic groups. The climax of the week-long program was a banquet and dance attended by 400. Eugene W. O'Brien, past-president of ASME, technical publisher, engineer, and editor of the *Southern Power Journal* and *Southern Power and Industry*, addressed the joint group on "The Engineer and His Civic Responsibilities."

At the helm of the **Indiana Section's Northwest Branch** next year will be Joseph Hnot, Jr., Highland, president; William D. Shillinger, LaPorte, vice-president; and Arthur P. Arndt, Gary, secretary-treasurer.

Recent developments in ground-water engineering were reported at the **Intermountain Section's** January meeting by John H. Peth, geologist and geophysicist. Dr. Peth's first-hand knowledge of current investigations in the Salt Lake Valley made the program of special interest. At the February meeting J. Leonard Love, chairman of the Utah Highway Advisory Council, discussed the overall highway picture, and E. G. Johnson, chief engineer of the State Road Commission of Utah, emphasized the need for cooperation in the interest of obtaining the badly needed highways.

The **Iowa Section** has awarded prizes of Junior Membership in the Society to two outstanding students—Merwin D. Dougal, of Iowa State College, and Elias G. Prentzas, of the University of Iowa. Presentation of the awards was made at a meeting in Des Moines on February 28, held in conjunction with the annual meeting of the Iowa Engineering Society. Carl A. Smedal, Ames attorney, discussed

the legal responsibility of the engineer and surveyor.

"How Does Your Employer Size You Up?" asked the **Kansas City Section's** Junior Activities Committee, which sponsored the program for the March meeting held at Kansas City University. The speakers' panel consisted of Dan Watkins, C. R. Van Orman, and Jasper Meals. The meeting was the first of a series the committee is arranging on employer-employee relations.

In the **Kansas Section** it's Dwight Metzler for president and E. R. Leeson for vice-president in 1956.

The prospect of pending (in Kentucky) legislation for retirement was discussed at the **Kentucky Section's** annual joint luncheon with the Kentucky Society of Professional Engineers, held in Lexington on January 21. Featured speaker was the Hon. Joseph J. Leary, prominent Frankfort attorney and member of the Governor's Advisory Committee for Legislation on Retirement.

Lee H. Johnson, dean of engineering at Tulane University, succeeds Roy T. Sessums as president of the **Louisiana Section.** Other officers, elected at a meeting on January 16, are Calvin T. Watts, first vice-president; B. A. Grehan, second vice-president; and Frank C. Fromherz, secretary-treasurer. In the featured talk on the growth of industry in Louisiana, Hugh Bowers, chairman of the industrial committee of the New Orleans Chamber of Commerce, forecast expansion in the petroleum, petro-chemical, chemical, and forestry fields.

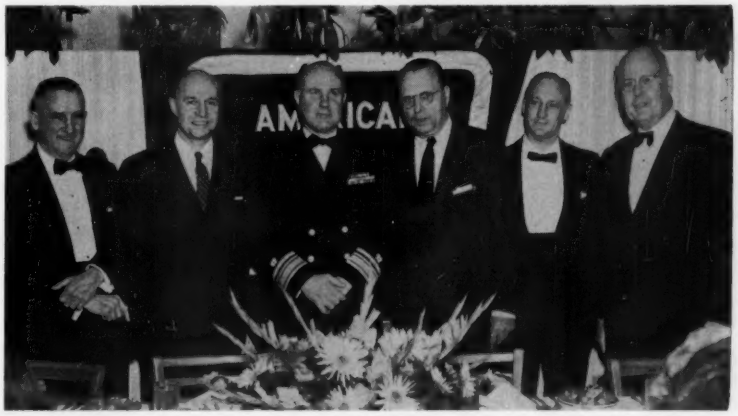
New **Maine Section** officers are Charles F. Parker, president; William H. Bradford, vice-president; William P. Kimball, vice-president for the New Hampshire Branch; Clyde N. Manwell, secretary; and Frank M. Taylor, treasurer.

The Chesapeake and Delaware Canal improvements and their relationship to the port of Baltimore were discussed at the February 8 meeting of the **Maryland Section.** Guest speaker was C. F. Wicker, engineering adviser to the district engineer of the Philadelphia District of the Corps of Engineers.

In opposition to pending legislation to amend the New York State Education Law, the **Metropolitan Section,** through its board, has adopted a firm policy for measuring proposed amendments to the law. Its proposals emphasize that "Engineering service, whether offered by an individual or an organization, shall be recognized as a personal responsibility." At its January meeting the Section honored its 34 new Life Members, who received the customary certificates.

A talk on the breeder reactor, which will furnish power for the new Detroit Edison Plant to be constructed near Monroe, Mich., constituted the technical program for the **Michigan Section's** February meeting. Ruble A. Thomas, of Atomic Power Development Associates, Inc., gave an excellent talk on the project and showed the motion picture, " 'A' for Atom." At

New Board of Directors takes over in the Mid-South Section. Seated, in usual order, are Jackson Branch President Karl A. Dupes; Secretary-Treasurer Earl C. Meserve; Vice-President Frederick R. Brown; Past-President A. W. Hardy; and Little Rock Branch President William W. McMahon. Standing are Director J. Irby Seay, Jr.; Alternate Director Silas S. Scott; Director Roman C. Berzowski; Vicksburg Branch President Richard G. Ahlvin; and Directors Francis E. Hall, Charles A. Long, and Mark G. Garver. Absent are Director Ben T. Collier; Memphis Branch President Fred C. Walpole; and Mid-South Section President Lawrence A. Tvedt, who is seriously ill. Photo courtesy of Delta "Democrat-Times."



Viewed at head table at annual dinner of National Capital Section, held at the Army-Navy Country Club in Arlington on February 7, are (left to right) Frank L. Weaver, Vice-President of ASCE; Executive Secretary William H. Wisely; Rear Admiral Robert H. Meade, chief of the Navy Bureau of Yards and Docks and featured speaker; ASCE President Enoch R. Needles; ASCE Director Mason C. Prichard; and Section President Bernard F. Locraft. In developing his subject, "Highlights on Spain," Admiral Meade paid tribute to the fine cooperation achieved under architect-engineer contracts in the Spanish Base Construction Program, which he directed. President Needles addressed the group briefly on the need for the engineer on today's complicated projects to be an able administrator as well as a good engineer. The program also featured presentation of Life Membership Certificates to Daniel C. Walser and Warren E. Darrow. Honored in absentia were Franklin H. Craddock, Charles W. Fowler, Thomas B. Harris, and Dudley F. Holtman. There were 225 present.

New San Francisco Section officers are congratulated by retiring Section President Howard Wood (left). Reading from second from left to right, the new officers are Robert D. Dewell, president, and W. W. Moore and H. C. Medbery, vice-presidents. Mr. Dewell is the son of an early Section president and former Vice-President of the Society.

Attending semiannual barbecue sponsored by the Austin Branch of the Texas Section to honor graduating senior civil and architectural engineers at University of Texas were civil engineering graduates from University of Mexico, Mexico City, who were in Austin as guests of the Texas State Department of Health. Shown in usual order are Frank J. Von Zuben, Jr., senior engineer, Division of Sanitary Engineering, Texas Department of Health; Francisco Montejano, civil engineer, University of Mexico; V. M. Ehlers, director, Division of Sanitary Engineering; Dr. Henry A. Holle, State Commissioner of Health; and graduate students Reynold F. Cantu, Julio Munoz (Bolivia), Luis O. Garibay, Catarino Perez H., Fernando A. Vargas, Enrique Rodriquez, Ariel C. Vecario, Luis Rivera, and Javier C. Moreno. All are from Mexico City except Senor Munoz, and all are working for their M.S. in sanitary engineering. The barbecue featured a symposium on "What ASCE Means to Me," with talks by ASCE Director Raymond F. Dawson, Dave Williams, Ed Richardson, and Wayne Henneberger.

the March meeting a Life Membership Certificate was presented to Albert Roth.

The use of prestressed concrete in large structures cuts construction costs sharply, but its chief advantage in homes is the reduction in fire insurance rates. This was one of many interesting facts brought out by Mott L. Pevey, Jr., at a recent meeting of the **Mid-South Section's Jackson Branch.** Mr. Pevey said that homeowners realize as much as a 50 percent cut in fire insurance rates if the roof is of prestressed concrete instead of wood. Mr. Pevey is manager of the prestressed division of the Jackson Ready-Mix Concrete Co., the only firm in Mississippi making the product. Newly elected officers of the **Little Rock Branch** are William W. McMahon, president; William Isaacs, vice-president; and Eston E. Royse, secretary-treasurer. At a meeting of the **Vicksburg** Branch devoted to the highway program, T. C. Robbins, director of the Mississippi State Highway Commission, showed slides that graphically portrayed the needs of the national highway system. He also discussed some of the problems in education and public relations encountered in planning, financing, and building state highways.

In February members of the **Mohawk-Hudson Section** met with the Student Chapter at Rensselaer Polytechnic Institute and heard John Broughton, head of the New York State Geologic Survey, discuss the various mining operations in the state and their potential in peace and war. Of special interest was his report on recent finds of radioactive ores in the state.

The **Montana Section,** the sixty-fifth to be formed, is celebrating its tenth anniversary this year. It has 180 members in three Branches—North Central, Billings, and Helena. Currently the Section is seeking a suitable name for its successful newsletter, now in its second year but still nameless.

Frederick William Rice, structural engineer of Omaha, received his Life Membership Certificate at the **Nebraska Section's** annual business meeting in January. Coincidentally Mr. Rice is celebrating completion of fifty years in the profession as well as his long association with ASCE. At the **Southwest Branch's** January meeting George Siggins, of the Armco Metal and Products Company, pinchhit for the scheduled speaker, Bob A. Robinson, with a talk on corrugated pipe.

The **Northeastern Section** is petitioning the Board to change its name to the Massachusetts Section, since its membership is now confined to that state.

Bruce Johnson, project manager of the Bureau of Reclamation's Missouri-Souris Project, was featured speaker at a recent joint meeting of the **Northwestern Section** and the Society of American Military Engineers. He described the diversion of Snake Creek Arm of Garrison Dam.

New **Oregon Section** life members are Thomas W. Baker, Edward John Carrillo, Floyd P. Obee, Glenn S. Paxson, Ernest G. Rice, Eugene R. Walsh, and John J. Walsh.

The Walt Whitman Bridge—a cable suspension-type structure under construction over the Delaware between Southwest Philadelphia and Gloucester, N. J.—was program subject for the annual joint meeting of the **Philadelphia Section** and its **Central Pennsylvania** and **Trenton**

Branches, held in Philadelphia on February 14. Speakers were Clarence W. Hanson, partner in Modjeski and Masters, and Milton Brumer, partner in Ammann & Whitney. The two firms represented were the joint designers of the $83,000,000 structure, which will be ready for traffic early next year.

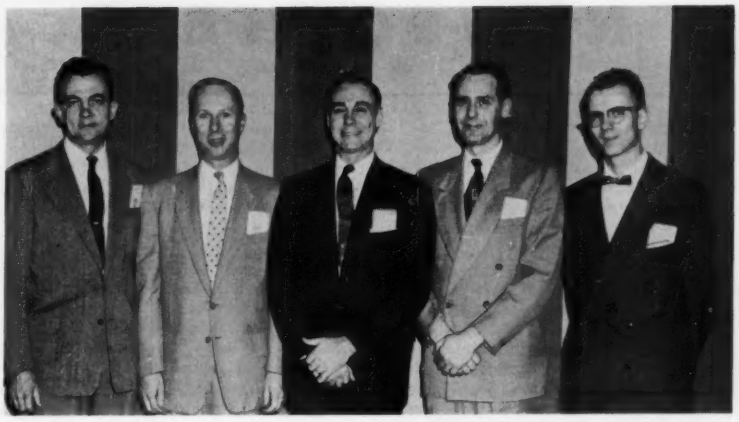
A conducted tour of the new Rochester Community War Memorial was enjoyed by members of the **Rochester Section** attending the February 15 meeting. Edward F. Nier, associate director of the memorial, did the honors.

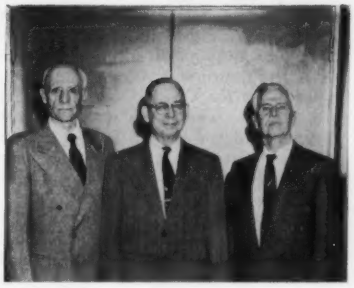
The Texas Towers were discussed at the **San Francisco Section's** February meeting. George Bauer, general superintendent of the DeLong Corp., which built the towers in a joint venture with the Raymond Concrete Pile Co., substituted very agreeably for the scheduled speaker, G. A. Fletcher, vice-president of Raymond. ASCE Director L. E. Elsener presented the 1955 Daniel Mead Award to Jerry Abbott, of Georgia Institute of Technology, who is now in the San Francisco area.

Plans for the forthcoming Mid-America Jubilee, to be held this coming September, were outlined at the **St. Louis Section's** February meeting by Alfred Stern, managing director of the exposition. Mr. Stern discussed the scope of the project and construction details of many of the structures, both permanent and temporary, that will be required for the undertaking. A. H. Lamack is chairman of the Section's newly appointed Publicity Committee.

In February more than 60 **Tacoma Section** members and guests were treated to a program dealing with construction phases of one of the important federal hydroelectric projects built in the state—the nearly completed Chief Joseph Dam on the Columbia River. Col. Norman A. Matthias, Seattle district engineer, was the speaker. Adding to the interest of his talk was the fact that the entire construction sequence of the project was graphically illustrated by on-the-spot colored photographs and slides. An old-fashioned chicken dinner at McChord Air Force Base Officers' Mess preceded the meeting. The Section reports that it looks like a banner year, with more than 50 percent of the members paying their dues at the outset of the year.

The new slate for the **Venezuelan Section** is Enrique Jorge Aguerrevere, president; L. M. Shumaker, vice-president; Santos Michelena, secretary; and Rene Bustamente, treasurer. Featured speaker at the Section's January meeting was Eduardo Rohl, director of the new Cajigal Observatory in Caracas, who described construction features of the project and the instruments that will be installed in it.





Seattle Section officers for 1956 are, in usual order, Emil Jensen, past-president; William Enkeboll, vice-president; Hanford Thayer, president; Nolan Daines, secretary; and Donald Hertzog, treasurer. Small view shows new life members—Carl Pollock, N. Henry Gellert, and E. L. Strandberg.

Coming Events

Hawaii—Annual Conference at the Princess Kaiulani Hotel, Honolulu, April 24. A tour of Hawaii is being arranged for visitors to the Pacific Southwest Council, leaving Los Angeles by Pan-American World Airways or United Air Lines, April 21 or 22. Details and reservations from Arthur Chiu, Department of Civil Engineering, University of Hawaii, Honolulu 14, Hawaii.

Ithaca—Dinner meetings in Ithaca on April 17 and May 3. At the April meeting Dean S. C. Hollister, of Cornell University, will discuss major findings of the Hoover Commission, of which he was a member.

Los Angeles—Host to the Pacific Southwest Council Conference at the Huntington-Sheraton Hotel, Pasadena, April 19–21. Sterling S. Green is general chairman.

Metropolitan—Meeting in the Engineering Societies Building, April 18, at 7 p.m. Meeting of the Junior Branch in the Engineering Societies Building, May 9, at 7:30 p.m. Guest speaker will be Ralph T. Walker, former president of the AIA and one of the country's most distinguished architects.

Mid-South—Spring meeting at the Hotel Lafayette, Little Rock, with the Little Rock Branch as host, April 26–28. Make reservations directly with the hotel.

Mohawk-Hudson—Meeting in the Troy Building, Rensselaer Polytechnic Institute, Troy, April 22. Featured topic will be "Recent Developments in Prestressed Concrete."

Northeastern—Joint dinner meeting with the Boston Society of Civil Engineers at the M.I.T. Faculty Club, April 23.

Rochester—Host to first meeting of District 3 Council, April 27–28.

Toledo—Host to annual convention of District 9 Council at the Secor Hotel, Toledo, April 13 (beginning at 8 p.m.) and 14. Details from William Gross, 2811 Letchwork Parkway, Toledo 6, Ohio.

Scheduled ASCE Conventions

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956

PITTSBURGH CONVENTION
Pittsburgh, Pa.
William Penn Hotel
October 15–19, 1956

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

NEWS BRIEFS . . .

ACI Revises Building Code at 52nd Annual Meeting

One of the important actions coming out of the 52nd annual meeting of the American Concrete Institute—held at the Bellevue-Stratford Hotel in Philadelphia, February 20–23—was expansion and revision of its Building Code Requirements for Reinforced Concrete. In a session devoted to the code, ACI Committee 318 made recommendations for revision, which were adopted. Most important of these is the recognition of the ultimate strength method of design of section by adding an appendix to the Code giving criteria for this method. The revised version of the chapter on flat slabs will have a greater practical value since it gives requirements in more detail. The chapter on column design has been largely revised. Formulas for concrete-filled pipe columns and columns with eccentric load have been simplified. New provisions increase shear reinforcement for diagonal tension near points of contraflexure. More reinforcement is required, particularly in the portions of beams which are lightly reinforced and in beams without an integrally cast slab. Frank Kerekes is chairman of Committee 318.

Besides modifying Section 801 (*d*) to carry web reinforcement a distance "d" beyond the point theoretically required, an additional section, 801 (*e*), has been added. This section reads: "Where continuous or restrained beams or frames do not have a slab so cast as to provide T-beam action the following provisions shall apply. Web reinforcement shall be provided from the support to a point beyond the extreme position of the point of inflection a distance equal to either one-sixteenth of the clear span or the depth of the member, whichever is greater, even though the shearing unit stress does not exceed v_c. Such reinforcement shall be designed to carry at least two-thirds of the total shear at the section. Web reinforcement shall be provided sufficient to carry at least two-thirds of the total shear at a section in which there is negative reinforcement."

Research Reported

A report by ACI Committee 214, under the chairmanship of William A. Gordon, research engineer for the Portland Cement Association, Chicago, covered the numerous variations that occur in the strength of concrete and presented statistical methods that are useful in interpreting these variations. Criteria, which can be used to establish specifications and maintain required uniformity, were offered.

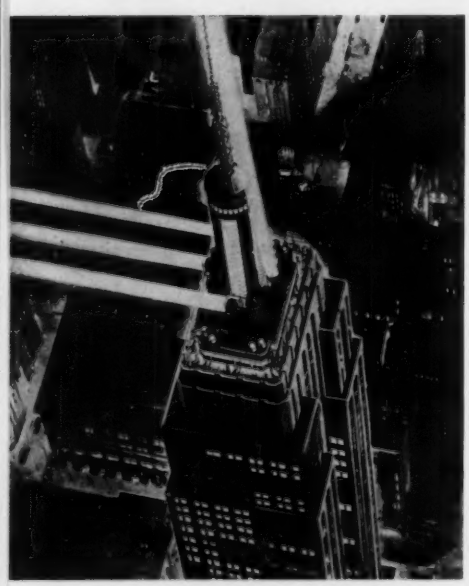
The opening session also included a report by ACI Committee 210 on "Erosion Resistance of Concrete in Hydraulic Structures." Walter H. Price, chief of the engineering laboratories, U. S. Bureau of Reclamation, is committee chairman. The report was concerned largely with the physical erosion of concrete in hydraulic structures resulting from particles carried by flowing water and from pitting caused by cavitation. The report notes that the erosion resistance of concrete increases as the strength of the concrete is increased. Materials and methods that tend to increase the strength of concrete at the surface or throughout the mass also increase erosion resistance. However, the report concludes, "The best concrete that can be made will not withstand the forces of cavitation or severe abrasion for a prolonged period."

Outstanding Projects Described

Four unique concrete construction projects were described during the Wednesday afternoon construction session. One of these projects was the 290-ft-dia dome over the new sports stadium in Havana, which represents a striking application of a thin-shell structure with prestressed edge member supported on columns. While thin shells are gaining in favor as covers or roofs for areas requiring clear span, it is believed that the Havana dome is the largest span constructed to date of a relatively flat segment of a spherical concrete shell with prestressed edge member. The author was J. J. Closner, vice-president of the Preload Co., Inc., New York.

One of the tall prestressed structures erected by the lift-slab method of construction is the Litchfield County Hospital, with five full stories and a solarium roof slab, now being built at Winsted, Conn. The solarium roof (41 × 80 ft × 8½ in.) will be lifted a total of 62 ft to its final position. The entire structure is supported by only fourteen 14-in.-wide flanged columns, each slab cantilevering on all four sides during erection. James M. Minges, consulting engineer of West Hartford, Conn., described the project.

Use of the prepacked method for placing over 400,000 cu yd of concrete in the 34 foundation piers of the Mackinac Bridge was discussed by Raymond E. Davis, Jr., and C. E. Haltenhoff, project engineers, respectively, for the Prepakt Co., Cleveland, and the Merritt-Chapman & Scott Corp., New York. Methods of overcoming problems of flooding (up to 9,000 gpm) and excessively high temperatures that proved troublesome during the lining



Spectacular Lights for Empire State Building

This is how the 102-story Empire State Building—tallest building in the world and one of the "Seven Engineering Wonders" selected by ASCE—will look this April when four super-powerful revolving and elevating lights are installed 1,092 ft above the streets of Manhattan. With total output of nearly 2 billion candlepower, the beacons will be visible in six states—at a distance of 80 miles on the ground and of 300 miles from the air. A complex system of synchronous controls will enable the beacons to revolve 180 deg in a horizontal plane, then to elevate individually and sweep the tower with light. The entire lighting installation is being handled by the Federal Sign and Signal Corp., of Chicago.

of the Tecolote Tunnel, making it one of the most difficult projects in the history of Bureau of Reclamation construction undertakings, were described by E. R. Crocker, project manager for the Bureau.

Other sessions explored factors influencing concrete shrinkage, with special application to the floors in a building put up at the Kodak Park Works in Rochester in 1939. The building was constructed as one 275-ft unit in order to permit a study of shrinkage in the continuous frame. Data for a 16-year period provided by Carlson electric strain meters, sunk horizontally and vertically in four floor slabs, indicate drying shrinkage in the order of 0.6 in. horizontally and 1.1 in. vertically. The studies were reported by Robert R. Sheridan and Morgan B. Klock, of the Eastman Kodak Co.

Prestressed Concrete Section

In an interesting session devoted to prestressed concrete, G. M. Nordby and William Venuti, respectively associate professor of structural engineering at Purdue University, and assistant professor of engineering at San Jose (Calif.) State College, presented the results of an investigation of prestressed concrete beams using steel strand as the prestressing medium. From data provided by the thirty beams tested to date, it was concluded (1) that expanded shale aggregates of the type tested make acceptable concrete for use in prestressed concrete structures; (2) steel strand is superior to smooth wire for use in bonded-type design; and (3) it is impossible to obtain fatigue failures of the beams when they are in an uncracked condition within 10 million cycles of load.

Award Winners Honored

Top award winner was Franklin R. McMillan, M. ASCE, who received the Henry C. Turner Medal "for forty years of outstanding leadership in discovering and disseminating knowledge of the basic principles of concrete and concrete construction." New ASCE Honorary Member John I. Parcel was presented the Alfred E. Lindau Award "for inspired authorship and teaching of structural principles applicable to reinforced concrete design." Charles S. Whitney, M. ASCE, Boyd G. Anderson, and Edward Cohen, J. M. ASCE, were awarded the Wason Medal for "the most meritorious paper" of the year, "Design of Blast Resistant Construction for Atomic Explosions," which appeared in the March 1955 ACI Journal. Keith G. Moody; Ivan M. Viest and Richard C. Elstner, Junior Members ASCE; and Eivind Hognestad, A.M. ASCE, received the Wason Medal for "noteworthy research" reported in their paper, "Shear Strength of Reinforced Concrete Beams," published in four parts beginning in the December 1954 issue of the ACI Journal. Morton O. Withey, M. ASCE, dean emeritus of the college of engineering at the University of Wisconsin, was made an honorary member of ACI.

Frank Kerekes New ACI President

Frank Kerekes, M. ASCE, dean of the faculty at Michigan College of Mining and Technology, and former long-time member of the Iowa State College engineering faculty, succeeds Mr. Whitney as president of the ACI. Douglas McHenry, M. ASCE, director of development for the Portland Cement Association, was elected vice-president for a two-year term, and Walter H. Price, M. ASCE, head of the engineering laboratories for the U. S. Bureau of Reclamation at Denver, will serve the second year of the two-year term to which he was elected last year.

Frank Kerekes

Contract Let for Expanding Bethlehem Steel Facilities

As part of its recently announced $300,000,000 expansion program, the Bethlehem Steel Corp. has awarded Koppers Company, Inc., a contract for the engineering and construction management of new steel-melting and primary rolling facilities at its Sparrows Point, Md., plant. The new facilities, which will make the Sparrows Point plant the largest in the world, will include an open-hearth shop with seven 350-ton open-hearth furnaces and auxiliary equipment. The open-hearth shop will increase the annual ingot capacity of the plant by some 2,000,000 tons of steel.

Construction of the whole project is scheduled for completion by the end of 1957.

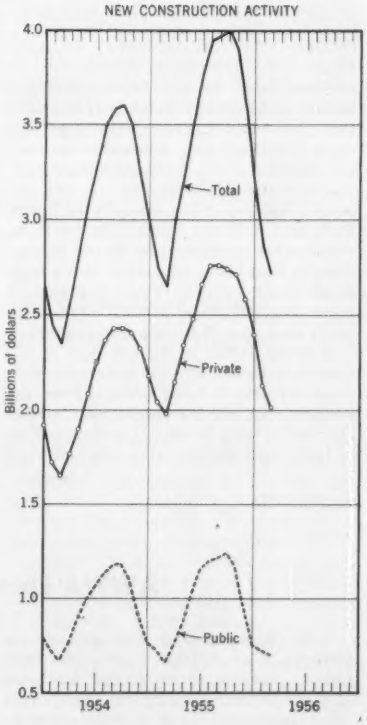
Construction Activity Declined Seasonally in February

While the $2.7 billion spent for new construction this past February represented a seasonal decline from January outlays, it matched the previous February record set in 1955, according to preliminary joint estimates of the Departments of Commerce and Labor. Expenditures for the month brought the total for the first two months of the year to $5.5 billion, virtually the same as the January–February 1955 figure. On a seasonally adjusted basis, expenditures for new construction thus far in 1956 were at an annual rate of $41.5 billion, compared with the $42.3 billion total actually put in place last year.

Most of the 5 percent decline from January to February in private construction was due to a continuation of the downtrend in residential building activity that began late last summer. The decline in the number of new homes started this past fall and early winter meant that private spending for residential building in February dropped below the $1 billion mark for the first time since April 1954.

However, the value of work put in place on private non-residential building set a new February record. Industrial construction also was at a new high for any month, exceeding the January 1956 figure by 2 percent. Likewise, store building was up 3 percent over the previous month.

Although all major types of construction contributed to the 4 percent decline in public spending over the month, most types decreased at a rate more moderate than usual for the season. Expenditures for highway construction, public educational building, and sewer and water works were greater than in any previous February.



February outlays for new construction, at $2.7 billion, show seasonal decline from January but match previous February record set in 1955.

Bushy Park Industrial Water Supply Nears Completion

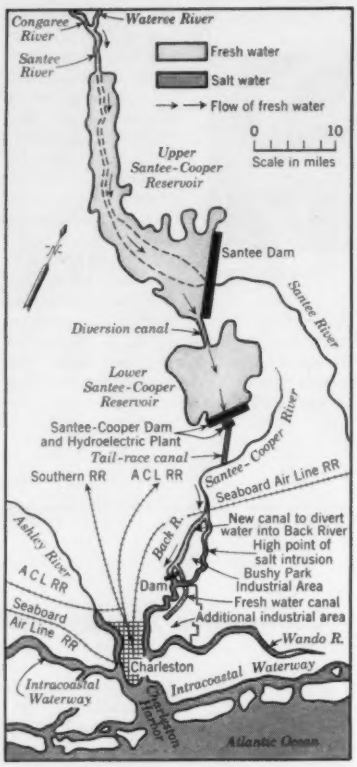
Some of the troubles of big industry in the Charleston, S.C., area will be over in July when the Bushy Park industrial water supply project is completed. The new development, which involves reshuffling of rivers, will assure water-starved industries in the South Carolina Low Country 10 billion gallons of fresh water daily, about one-eighth the total requirement of American industry. Best of all, the total cost of the project is estimated at only $4\frac{1}{2}$ million—a figure fantastically low, we are reminded, in comparison with the $800 million cost of the proposed Incodel Project, which would provide $1\frac{1}{2}$ billion gallons of Delaware River water to New York, New Jersey, and Pennsylvania.

The Bushy Park Project is a brilliant engineering scheme—devised by Arthur M. Field, M. ASCE, chief engineer of the Charleston Development Board, and furthered by Mayor William M. Morrison—to prevent waste of the 10 billion gallons of fresh soft water that were being discharged daily into Charleston Harbor from the Santee-Cooper hydroelectric plant 40 miles upstream from the city. This tremendous volume of water was unfit for industrial use in plants along the ship channel because of contamination from salt water running up the Cooper River with each incoming tide.

Basically the project involved diverting the daily flow from the hydroelectric plant into Back River, a short parallel stream, by means of a canal and then closing Back River by constructing an earthfill dam at its lower end. In addition to forming a barrier to block salt-water intrusion into the fresh-water reservoir, the dam will carry a railroad spur connection between the mainline of the Seaboard Airline Railroad and the industrial area. It will also carry a highway giving access to the Bushy Park area from the South. Bushy Park, which takes its name from an old plantation, is thus being converted into a huge fresh water reservoir (with capacity of more than 800 billion gallons) adjacent to plant sites on a 35-ft-deep ship channel.

A prime factor in the low cost of the project is the fact that the material used to form the dam is being dredged from the river bottom, eliminating the costly operation of bringing in fill. The composition of the Cooper River marl is such that when it is exposed to air and water it acts like a natural mortar, with the exposed surface hardening and becoming practically erosion-proof.

The New York engineering firm of Ford, Bacon, and Davis are the consultants on the project.



Reservoir of Bushy Park development, with its portside industrial supply of 10 billion gallons of fresh water daily, is being formed by earthfill dam at lower end of Back River. Cooper River, bordering the industrial sites, offers perfect means of effluent disposal without expensive treatment.

AWWA Elects New Officers

Paul Weir, general manager of the Atlanta (Ga.) Water Works, has been elected new president of the American Water Works Association, and Fred Merryfield, professor of sanitary engineering at Oregon State College, Corvallis, has been elected vice-president. William W. Brush, editor of *Water Works Engineering*, New York, has been reelected treasurer. All are members of ASCE. They will take office at the 75th anniversary meeting of the AWWA which will be held in St. Louis, May 6–10.

During the presentation of medals and awards, which will be another meeting feature, Fred G. Gordon, M. ASCE, will receive the 1955 Diven Medal for his constructive leadership of the organization's Committee of Standard Specifications for Metal-Seated and Rubber-Seated Butterfly Valves. The Goodell Prize for a paper on research will go to five engineers with the Los Angeles Department of Water and Power—H. S. Swanson and H. J. Chapton, Associate Members ASCE; C. L. King, J.M. ASCE; E. D. Nelson and W. J. Wilkinson. Abel Wolman, M. ASCE, will receive the Management Division Award, and Finley B. Laverty, M. ASCE, the Resources Division Award for the best papers published during the year from two of the association's four major Divisions.

Export-Import Bank Loan for Philippines

A credit of $65,000,000 has been made available to the Republic of the Philippines for developing the economy of the country by the Export-Import Bank of Washington. Called "an expression of confidence of the U. S. Government in the future prospects of the Philippines," the loan will provide for purchase in the United States, for export, of machinery, equipment, materials, and services required for various development projects.

The Philippine Government is encouraging an industrial development program that includes developing the hydroelectric potential of the Agno River in northern Luzon. The proposed Binga Dam is also under consideration.

First Private Atomic Plant Will Be Ready in 1957

The nation's first privately financed atomic electric power will be generated in 1957 near San Francisco, Calif. This announcement comes from the General Electric Company which, together with the Pacific Gas and Electric Company, will operate an atomic-electric plant in the Livermore-Pleasanton area, 40 miles southeast of San Francisco.

Steam for power generation will be supplied by a 5,000-kw experimental plant of the boiling-water type. In this experimental plant, which is part of an atomic laboratory that General Electric will build for development of peacetime uses of atomic energy, steam from the nuclear reactor will feed into a turbine-generator provided by the Pacific Gas and Electric Company for transmission over the P. G. & E. network. Integration of the nuclear phases of the plant will be the responsibility of General Electric.

In addition to being the first privately financed plant to go into operation, the unit will mark the first generation of power from a boiling water reactor designed for dual-cycle operation. The unit is a pilot plant for the 180,000-kw station to be built near Chicago by General Electric for the Commonwealth Edision Company.

New Jersey Authorizes Building of Narrows Span

Construction of the long-debated Narrows suspension span connecting Staten Island and Brooklyn became a virtual certainty on March 12 when the New Jersey State Senate voted to authorize the Port of New York Authority to undertake the project. Similar approval is expected from the Assembly, and Governor Meyner has indicated that he will sign the bill at once. New York State has already adopted the necessary legislation. Action by both states is required because the Port of New York Authority is a bi-state agency.

With a 4,400-ft-long clear center span, the bridge will be the longest in the world. In addition to relieving the traffic load now carried by the Holland and Lincoln tunnels, the twelve-lane double-deck structure will also expedite the flow of vacation traffic from New York and New England to New Jersey resort areas. Estimated cost of the project is $220,000,000. The New York consulting firm of Ammann & Whitney was engaged to prepare the preliminary plans and cost estimates for the Port of New York Authority and the Triborough Bridge and Tunnel Authority.

World's Largest Repair Hangar Nears Completion

Aerial view shows a $13,000,000 maintenance and repair hangar which is being completed this spring at Kelly Air Force Base, San Antonio, Tex. Believed to be the largest facility of its type in the world, the mammoth structure will permit maintenance simultaneously on both a "production line" and "stall" basis on all types of aircraft. Entire project covers a ground area of over 1,000,000 sq ft and includes a hangar 2,000 ft long, 300 ft wide, and 91 ft high; an adjacent shop building 1,650 ft long by 250 ft wide; and a 16-in.-thick reinforced concrete apron designed to support planes weighing up to 400,000 lb. The hangar proper is divided into five independent bay units of 400 ft each and can admit the largest planes through its 250-ft door openings. Project was designed and engineered by the Kuljian Corp., Philadelphia, and built by Farnsworth & Chambers, of Houston, under direction of the Air Installations Division, AMC, Wright-Patterson Air Force Base, Ohio.

A. E. D. Takes Firm Stand On Federal Road Program

Members of the Associated Equipment Distributors in attendance at the organization's recent 37th annual meeting, held at the Conrad-Hilton in Chicago, pledged themselves to do "all possible to see acceptance and adoption of the Federal Highway Program this year." During the five-day meeting a resolution was passed urging prompt congressional action on the proposed program.

The program was featured in major addresses given during the meeting, which also provided members with up-to-the-minute management information for better methods and practices in the distribution of construction equipment. Theodore Koop, director of news and public affairs for the Columbia Broadcasting System in Washington, D. C., and Welcoming Luncheon speaker, gave a concise picture of prospects for highway legislation this year. "It is too early," he said, "to predict exactly what financing program will be approved, but one thing is certain: it will be a pay-as-you-go program rather than a bond issue."

Mr. Koop added, "We can be reasonably sure that the House will pass and Congress will finally enact a highway-aid program this year.... There is apparent agreement as the result of a bipartisan conference on January 27 that a substantial boost in taxes on highway users would be necessary. Speaker Rayburn has indicated that the new taxes would include a one-cent boost in the present two-cent tax (federal) on gasoline, and higher levies on diesel fuel and tires."

In a talk on "Construction's 1956 Responsibilities," George Koss, then president of the Associated General Contractors of America, noted that "The construction industry has a responsibility for 1956 just as it has had for the years past—and that is to provide a physical plant for the needs of our people. To sum it all up, there is only one good reason for building a bridge, and that is so someone can get to the other side of the river."

New A.E.D. officers for 1956 and seven regional directors took office during the meeting. Stanley F. Laskey, of Northwestern Equipment Inc., Fargo, N. Dak., succeeds Ray J. Finn, of Cincinnati, as president. L. Miner Doolen, of the Telford Equipment Co., Lansing, Mich., is executive vice-president, and H. D. Anderson, of the Rish Equipment Co., Bluefield, W. Va., will serve as vice-president for a second term. New vice-presidents are F. J. Fitzpatrick of Hyde Park Mass., and D. C. Campbell, of Fredericton, N. B. J. R. Borchert, of St. Paul, Minn., is treasurer.

NSPE Dedicates New Building in Washington

The new $400,000 headquarters building of the National Society for Professional Engineers, recently completed in northwest Washington, D. C., was formally dedicated during the NSPE's spring meeting in February. The dedication ceremonies were conducted by NSPE President Allison C. Neff, M. ASCE, who cut a ribbon at the door of the building. Featured speaker was Brig. Gen. Thomas A. Lane, M. ASCE, Engineer Commissioner of the District of Columbia.

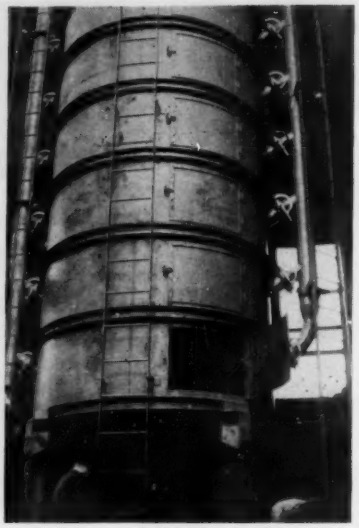
The structural engineers for the project were Beall and LeMay, and the mechanical and electrical engineers C. Warren Bogan and Associates, both of Washington. Lawrie and Green, of Harrisburg, Pa., were the architects, and Justement, Elam, and Darby, of Washington, the associated architects. Financing was handled through the sale of building fund participation certificates to the membership.

Digester Converts Sawdust Into Humus

Sawmills faced with accumulations of sawdust—ever the bane of sawmill operators—will probably soon be able to dispose of this waste at a profit. More than thirty large sawmill companies are anxiously awaiting the results of a pilot project on sawdust digestion that is being carried out by the Organic Pacific Company of Oregon. The project, which has been under way for a year, has established the fact that certain selected bacteria can convert sawdust into a fine granular humus. The key to the process is an eight-deck continuous-flow digester, similar to a large incubator, with moving plows that slowly propel the waste through the various decks. Air for decomposition of the waste and the needs of the bacteria is controlled by air pipes with adjustable dampers. Nutrients are added to enrich the humus.

The digester is patented, and the invention of Dr. G. H. Earp-Thomas, of Hampton, N. J. The first commercial-sized unit for processing sawdust is nearing completion in Oregon. Its capacity will be 50 tons a day. Smaller units are already in successful use for processing garbage which, when reinforced with phosphates, is sold as complete organic fertilizer. One city is adding sewage sludge to its garbage, and the digester converts it into an odorless granular humus by the continuous-flow process.

The cost of the digester being built in Oregon will be about $30,000. Cost of operation without overhead will be $3.50 per ton of humus. The reinforcing materials, mainly natural phosphates, will average about $6.00 per ton of finished organic fertilizer. Where sewage sludge or garbage is available, the cost will be less both for bacterial food and the fertilizer.



Earps-Thomas continuous-flow digester utilizes plow assembly to convert sawdust into odorless granular humus. Commercial-sized unit being built in Oregon will have capacity of 50 tons per day.

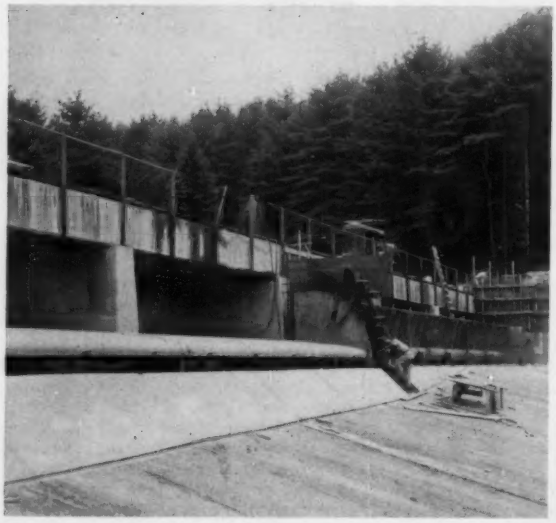
The cost of making fertilizer for root crops and garden truck will be about $2.00 higher per ton. The complete organic fertilizer will be uniform in quality regardless of the basic organic waste used. The uniformity is due to the production of growth factors by the bacteria used, such as actumus, auxin, and kinin.

Central America Pushes Pan-Am Highway Work

With completion of the Pan-American Highway to the Panama Canal their goal, the countries of Central America are maintaining an accelerated construction program, according to Norman B. Wood, A.M. ASCE, chief of the Inter-American Office of the U.S. Bureau of Public Roads. Quoted in a recent issue of *World Highways*, publication of the International Road Federation, Mr. Wood reports that contractors working on the 175-mile route between the Mexican border and Guatemala City will soon open up what is now the major bottleneck in the highway. Thompson-Cornwall, Inc., of New York City, now has three contracts totaling $7.5 million on the sector in northern Guatemala.

This spring both Honduras and Nicaragua are advertising for bids. In its first construction work undertaken since 1947, Honduras will request bids for grading and drainage on a short section near the Nicaraguan border and for widening and construction of the base course on a 20-mile sector between Cholatecca and San Marcos. Nicaragua will replace ten emergency bridges, erected by the U. S. Army Engineers during the war, with permanent structures.

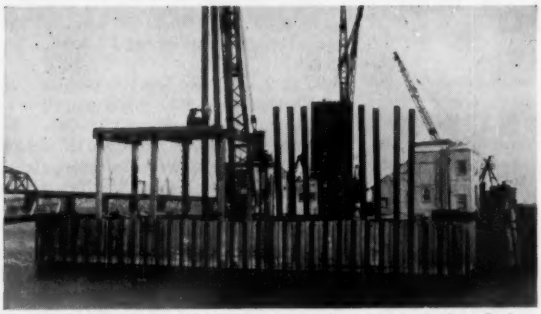
In Costa Rica, where construction of a 30-mile sector in the canyon area of the Disquis River will be started this spring, 130 miles of the highway must still be built. El Salvador, however, will complete the last stretch of its 195-mile section of the highway this July. All of it conforms to standards, including paving, set up for the highway in the Central American Republics.



Bascule Dam Gates Capture Reserve Water

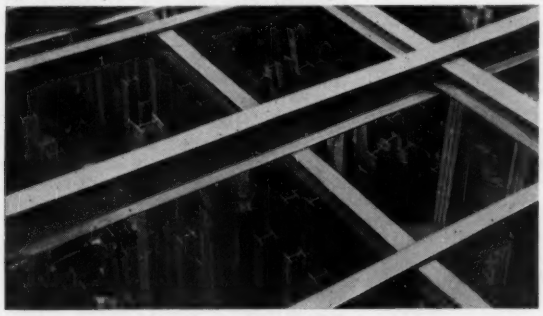
When these new bascule gates for York (Pa.) impounding dam were closed for the first time, they made it possible to trap more than 350,000,000 gal of reserve water in three days by raising the reservoir level an additional 4 ft. It took more than two months to collect the same amount of water in the fall of 1954 following the summer drought. Raising the dam cost the York Water Co. about $300,000. Each of the two gates is 4 ft high by 93 ft 8 in. long and is operated from one end with hydraulic cylinders. Installation includes a central accumulator system and control panel and float controls and compensating mechanism to assure simultaneous operation. The gates were manufactured by the S. Morgan Smith Co. and installed by the H. J. Williams Co., both of York. Consultants on the project were Alvord, Burdick, and Howson, of Chicago.

Newark Bay Bridge piers rest on Bethlehem H-piles



Driving Bethlehem H-piles during construction of Newark Bay Bridge.

Bethlehem H-piles were cut off after driving to bedrock in cofferdams.



Newest link between New York City and points to the south and west is the $40 million Newark Bay Bridge. This project of the New Jersey Turnpike Authority is part of eight miles of expressway which will connect the Holland Tunnel with the Turnpike at the Newark Airport interchange.

With approaches, the bridge is 9,500 ft long, stretching from the abutment on the east end to the beam spans of the connecting viaduct on the west. There are two 36-ft roadways, each containing three lanes and separated by a 4-ft center mall.

Bethlehem furnished 16,600 tons of steel H-piles for the Newark Bay Bridge. Dravo Corporation, of Pittsburgh, was contractor for over-water piers; Merritt, Chapman & Scott Corporation, New York, was contractor for land-based piers and abutments. Howard, Needles, Tammen & Bergendoff, of New York, were consulting engineers for the project.

The Bethlehem steel H-piles used in the project were furnished in single pieces up to 100 ft in length, and spliced for lengths of from 100 ft to 128 ft. They were driven through meadow marsh to bedrock.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

New West Coast Award Honors Construction Men

Two ASCE Members —Julian Hinds (right) and Nathan Bowers (center) — were among thirteen prominent West Coast heavy construction men honored by the newly formed Beavers. They are shown here with W. A. Johnson, 1955 president of the organization, at the recent first annual awards dinner in Los Angeles.

Alpha Portland Co. to Expand St. Louis Plant

As part of an integrated program for increasing plant capacity, the Alpha Portland Cement Co. is planning to spend about $6,860,000 for expanding the facilities of its St. Louis plant. The present construction program will feature an 11-ft-dia by 380-ft-long kiln and cooler with corresponding new accessory equipment and building. Ten additional cement storage silos and a bulk-loading plant are included in the program.

Miami Undertakes Big Improvement Program

To keep abreast of the needs of its fast-growing population, the City of Miami will spend $10,261,825 on municipal improvements this year. With the exception of a new $28,000,000 sanitary sewerage system, which will be completed with an expenditure of $760,000 this year, the program is the most ambitious undertaken by the city since the end of the war. Sidewalk, street, and highway development, totaling $2,375,000, will top the list of scheduled projects. Another million and a half will be spent in acquisition and development of off-street parking facilities, and $1,096,825 has been earmarked for expansion and improvement of park projects during the year. Bonds sold within the past fifteen months will finance most of the work.

Arthur E. Darlow, M. ASCE, is city engineer.

R. ROBINSON ROWE, M. ASCE

"I'm impatient to learn,' began the Professor, "whether Al E. Dayde's surveying problem turned out to be an easy one that looked hard, or a hard one that looked easy."

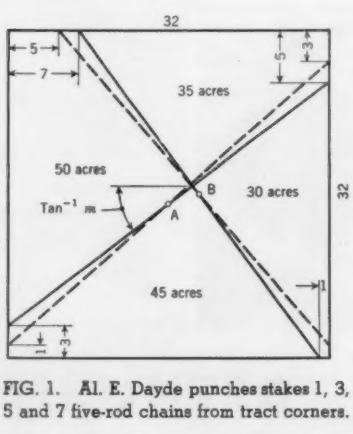


FIG. 1. Al. E. Dayde punches stakes 1, 3, 5 and 7 five-rod chains from tract corners.

"I called it 'nearly easy,'"

"Why?"

"Well," answered Joe Kerr, "Al had to divide a 160-acre tract with two perpendicular lines into 4 lots in the ratio 6:7:9:10, so the areas were 30, 35, 45 and 50 acres, respectively. I drew a N-S line dividing the tract so as to have 65 acres for the smaller lots on the east side. Then I drew an E-W line so as to have 75 acres on the south side. That was easy, and it nearly worked, but the SE lot is 30.47 acres instead of 30 and each of the others is off by about a half acre. I hope that's near enuf."

"Not nearly near enuf," chided Cal Klater. "For a probate court it has to be exact, or at least look exact. Joe's lines intersected center lines of the tract at A and B (Fig. 1). If they are rotated in phas counterclockwise about those points, the southeast lot gets smaller. Its area can be expressed in terms of m, the tangent of the angle of rotation; equating this area to 30, I found $m = 0.75$ from the relation

$$m = \frac{(d-a)^2 - (c-b)^2}{2(d-a)(c-b)} \quad . \quad . \quad (1)$$

where areas are in the ratio $a:b:c:d$ in order of magnitude and, as in this case, $b - a = d - c$.

"In laying out the corners, Al will find it convenient to use the commendable but obsolete super-Gunter 5-rod chain, setting decree corners 1, 3, 5, and 7 chains from tract corners and then intersecting the two diagonals for his fifth corner."

"And if anyone wants to compute the dimensions of the lots," added the Professor, "he'll find them all rational, the figure being a composite of 3-4-5-triangles. In fact...."

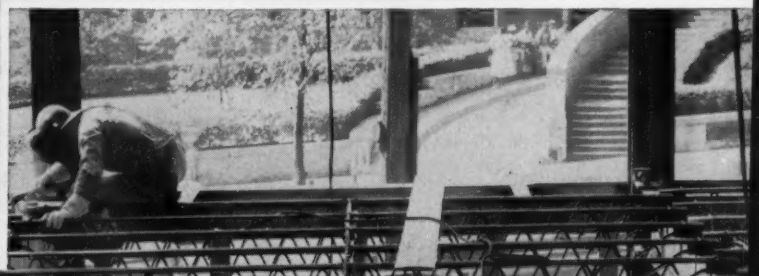
"Can I add something," begged Cal. "If I had continued the rotation until $m = 0.8125$, the line thru B would have hit the SE corner, after which the area of the SE lot would increase to reach 30 again, giving the second solution shown by the dotted lines when $m = 0.875575886$."

"The judge would have forbidden triangular lots if he'd been as smart as Cal. Now I'm leaving early to catch a plane for the Pasadena Conference, leaving Guest Professor Sauer Doe to recite the new bamboozler."

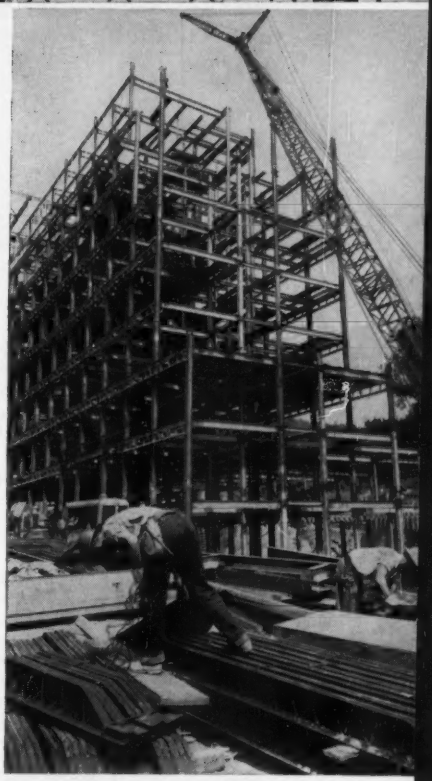
"It won't bamboozle if you start right," promised Professor Doe. "Esseyeville's new scramble system gives pedestrians 10 sec of each minute at all intersections and each is to be striped for the new diagonal lanes. An O-D pedestrian survey shows that $^1/_2$ the trips are to the next block, $^1/_4$ to the second block, $^1/_8$ to the third, and so on, where 'block' means the premises on one side of a street between intersections. What should be the diagonal share of the peripatetic traffic?"

[Cal Klaters were: Richard Jenney, Paul Hartman, Kum Pewter (Walter Steinbruch), Flo Ridan (Charles Edson), Sauer Doe, the Guest Professor (Marvin Larson), O'Kay (Otto Koch), Robert S. Johnson, Thatchrite (Guy C. Thatcher), G. H. Wilsey, I. Solvum Esy (P. H. Skarin), H. Francis Finch, and S. K. Rueball (Keith Jones).]

GRADUATE SCHOOL OF PUBLIC HEALTH, University of Pittsburgh, Pittsburgh, Pa.
Eggers and Higgins, Architects
Weiskopf and Pickworth, Structural Engineers
Mellon-Stuart Company, General Contractor



New-Design Steel Joists speeded erection of this handsome 8-story building



USS AMBRIDGE Steel Joists for floor and roof supports contributed materially to the speedy erection of the University of Pittsburgh's new Graduate School of Public Health building.

This modern 8-story structure is 64′-1″ wide x 297′-8″ long, with two wings, one 26′-5″ x 60′-0″, and one 36′-4″ x 70′-0″. The total weight of structural steel, including 122 tons of new-design steel joists, is 1,141 tons, all of which was fabricated and erected by American Bridge.

USS AMBRIDGE standard Steel Joists provide rigid, economical and lightweight construction suitable for any type of floor, roof and ceiling. The underslung and open web design provides for maximum head room and allows passage of pipes, ducts and conduits in any direction.

In floor construction, the ease and simplicity of handling this new-design steel joist reduces installation time to a minimum and permits other trades to begin their work promptly. And, for roof construction, AMBRIDGE Steel Joists cut the time required to put your structure under cover.

AMBRIDGE Steel Joists—standard and longspan — are fabricated and assembled on a modern production line basis to assure you a *better* product in *faster* time, thus enabling you to build an economical structure without interruption of your schedule. *Your joists are ready when you are ready for them.*

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THE READERS WRITE

World's longest tunnels—where are they?

TO THE EDITOR: Where are, and what are, the world's longest tunnels?

The Denver Water Board is trying to find out, so that when the 23-mile Harold D. Roberts Tunnel for the Denver Water system is completed under the Continental Divide of the Rocky Mountains in Colorado, it can be compared as to length with other major bores in various parts of the world.

It has been suggested that readers of CIVIL ENGINEERING might enter into a profitable and enlightening discussion of tunnel lengths and records. There is, apparently, no single standard compilation of figures on tunnel lengths. All information assembled by the Denver Water Board thus far has been piecemeal and fragmentary.

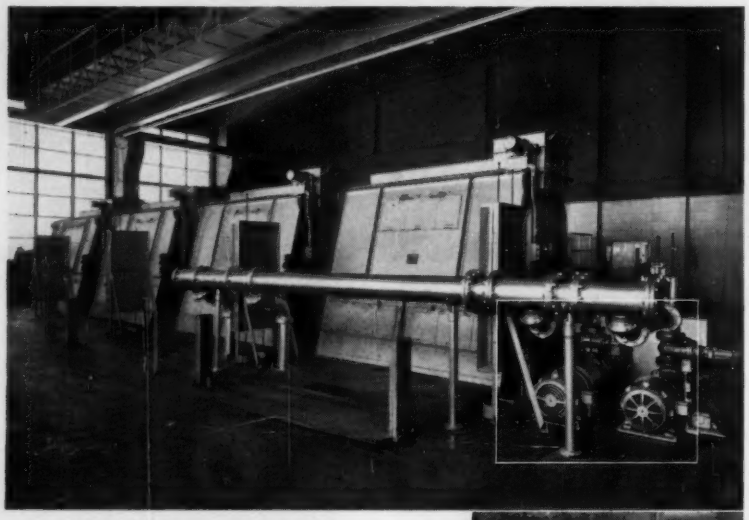
The American Society of Civil Engineers provided a "starter list" of five identifiable tunnels, to which has been added the reported dimensions of the Harold D. Roberts Tunnel (Denver Water Board project) and of the San Francisco Coast Range Tunnel (checked by the engineering staff of Ingersoll-Rand).

The current "nominations" for the world's longest tunnels (together with sources of data) are as follows:

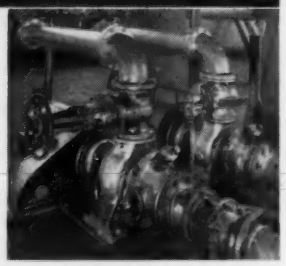
1. Delaware Aqueduct, water supply for City of New York, 85 miles (American Society of Civil Engineers).
2. East Delaware Tunnel, water supply for City of New York, 25 miles (ASCE).
3. San Francisco Coast Range Tunnel, 25 miles (Ingersoll-Rand).
4. Harold D. Roberts Water Tunnel, 23 miles (Colorado Project of Denver Water Board).
5. West Delaware Tunnel, water supply for the City of New York, 20 miles (ASCE).
6. Alva B. Adams Tunnel, Big Thompson Transmountain Diversion Project, Colorado, 13 miles (ASCE).
7. Simplon Railway Tunnel, Switzerland, 12½ miles (ASCE).

The measurements given above are for the longest sections of tunnel that are completely underground. Some tunnels are parts of systems which involve a greater mileage, but with only part of it underground. For instance, the San Francisco Coast Range Tunnel is reported to have an overall length of 29.2 miles, but it is divided into three segments: 25.0 miles of tunnel, 0.6 mile of "daylight," and another 3.6 miles of tunnel. Only the longest underground section (25 miles) has been included in the list of the world's longest tunnels.

RAY E. PETERSON
Information Officer,
Denver Water Board
City and County Building,
Denver, Colo.



General view of screen room at Hyperion with Type S Screens at left and Disintegrators at right.



Closeup of Disintegrators. Units were added to existing screening installation without expensive structural alterations.

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Italian practice in design of concrete structures

TO THE EDITOR: I found the article by Edward Cohen, "Rigid-frame Failure Raises Questions as to Design Assumptions," in the February issue, especially interesting. It is a rarity to find such a complete report of the failure of a reinforced concrete structure.

The behavior of concrete structures is a very complex matter. Concrete does not strictly obey the rules of elasticity.

Plastic flow, delayed strain, and deformations should all be considered.

I noted that an examination was made of European building codes in an attempt to modify the standard design assumptions. It might be of interest in this connection to discuss the design procedures generally followed in Italy for concrete structures.

It is generally accepted here that the mid-span positive moment should not be computed assuming perfect continuity and fully developed negative moment, because of plastic flow of the concrete and eventual settlement of supports which cannot be avoided or foreseen. The sum of midspan and negative moments is therefore a little greater than the theoretical $wl^2/8$.

Straight bottom bars are always anchored to the supports or intermediate columns and are carefully checked for bond and anchorage. No beam or frame is designed without trussed bars, which are generally extended beyond the supports in order to provide adequately for negative moments. When the total shear force exceeds the accepted value (depending on the cement and mix employed), the *total* shear must be taken by the reinforcement, partially by stirrups and partially by trussed bars.

The above assumptions may be "on the safe side" but generally assure safe structures with little or no more expense than is required for structures without adequate stirrups or trussed bars.

It should be mentioned that good practice calls for the anchorage of bars at points where the concrete is in compression in order to avoid cracks. Thus straight bottom bars are anchored at the supports in areas of negative moment, and trussed bars in adjacent bays at points of contraflexure.

I have found many old concrete structures that were designed on the assumption of full continuity, with web reinforcement designed to take only the *excess* shear, and main reinforcement not anchored over the supports. All such structures showed some distress—cracks or failure.

I think therefore it is safer to use high tensile steel and a high allowable stress, and to provide for full shear and adequate anchorage of reinforcement.

PIOTR WERTENSTEIN
Structural Engineer

Milan, Italy

Continued progress in earthquake-resistant design

TO THE EDITOR: The valuable analytical studies of the Alexander Building in San Francisco by Prof. Ray W. Clough, described in his article in the January issue (p. 54), are an important addition to research studies previously made by Messrs. Blume, Rinne, and Robinson on this structure.

Several points however merit further consideration. It appears that the value for shears in Fig. 3 should be 3.24 for the Uniform Building Code (UBC) and 2.10 for the Proposed Code of the Joint Committee (JCC). This value of 2.10 is predicated on using a 50-lb live load for 14 floors. To the writer, the difference in the magnitude of the base shears is not of the same order of importance as the manner in which the shear forces (shown in Fig. 2) vary with the height. Base-shear values in building codes are not the product of rigorous analysis. On the other hand, much theoretical work has been undertaken to develop a satisfactory shear envelope to obtain a factor of safety that will be as nearly uniform as possible throughout the height of the structure.

The accompanying Fig. 1 shows shear curves for uniform acceleration, for the UBC, the JCC, and the theoretical curve for the Alexander Building. It will be noted that the curve for the UBC is different from that shown in Fig. 2 of Professor Clough's article.

It is of interest to note that in "Numerical Analysis of Earthquake Response of a Tall Building," by T. P. Tung and N. M. Newmark in the October 1955 Bulletin of the Seismological Society of America, the comparison of shears shows the Joint Committee shear in the upper stories to be less than those obtained from theoretical studies reported. A comparison made by the writer using the UBC values, shows the shears in the upper stories to be approximately of the same order of magnitude as the Tung-Newmark theoretical shears. Thus we observe that the shear envelope

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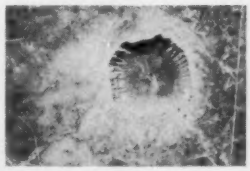

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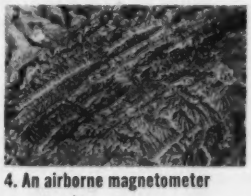

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(*Continued from page 97*)

will depend on the shape of the structure. In the slender Alexander structure, the JCC values approximate the theoretical values, whereas for the stiffer Tung-Newmark structure, the UBC values approximate the theoretical values.

The important point is that both the Uniform Building Code and the Joint

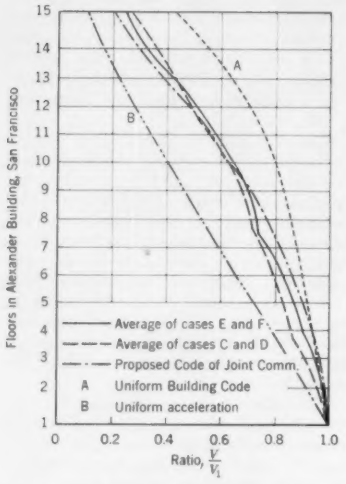

FIG. 1. Earthquake-induced shear forces plotted for Alexander Building, San Francisco, Calif.

Committee Code are definitely sound developments as compared with the earlier method of uniform acceleration and point the way toward continued research and continued progress on this and other phases of earthquake resistant design.

It might be said that the order of importance of the earthquake problem is as follows:

1. How a structure responds to earthquake ground motion.
2. Knowledge of actual earthquake damage.
3. Shape of the shear envelope.
4. Base shear coefficient.

R. W. BINDER, A.M. ASCE
Chief Engineer, Fabricated Steel Construction, Bethlehem Pacific Coast Steel Corp.
Torrance, Calif.

Author's comments

TO THE EDITOR: It has been brought to my attention that the earthquake provisions of the Uniform Building Code (UBC) were interpreted incorrectly in obtaining the UBC data for Figs. 2 and 3 of my article, "Earthquake Forces in a Tall Building," in the January 1955 issue. Corrected versions of these figures are presented herewith.

Two effects of this change should be commented on. First, it is now apparent that the UBC overemphasizes the shear forces in the upper stories of this tall,

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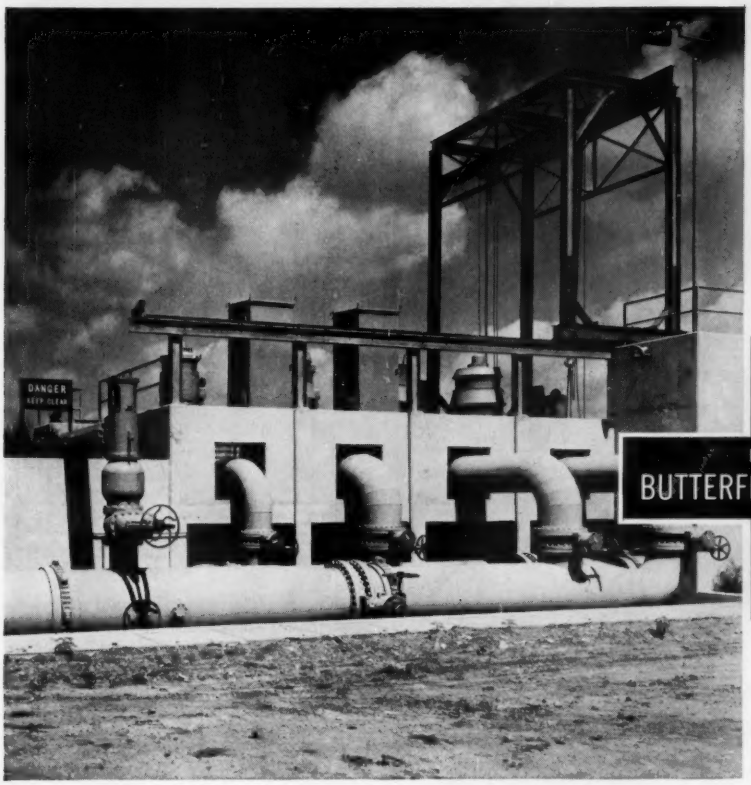

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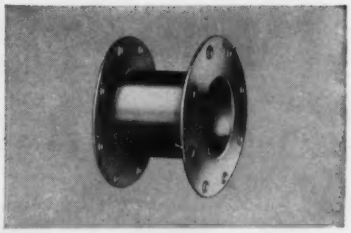

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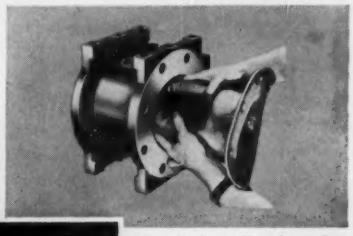
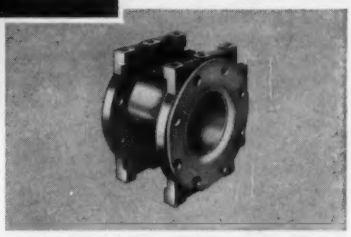


. . . Is installed in valve body . . .



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The Readers Write . . .

(*Continued from page 98*)

flexible building. The remarks of R. W. Binder (in his accompanying letter) regarding this point are very pertinent. It seems likely that the type of building, as

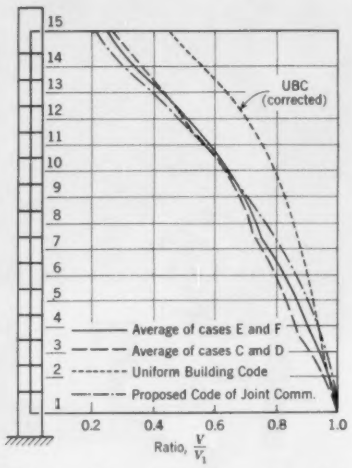


FIG. 2. (Corrected) Manner in which earthquake-induced shear forces vary with height is plotted for Alexander Building in San Francisco. (Note corrected curve for UBC.)

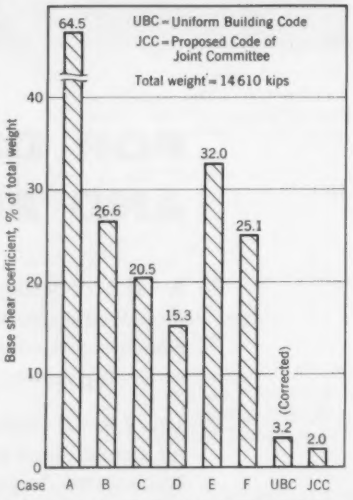
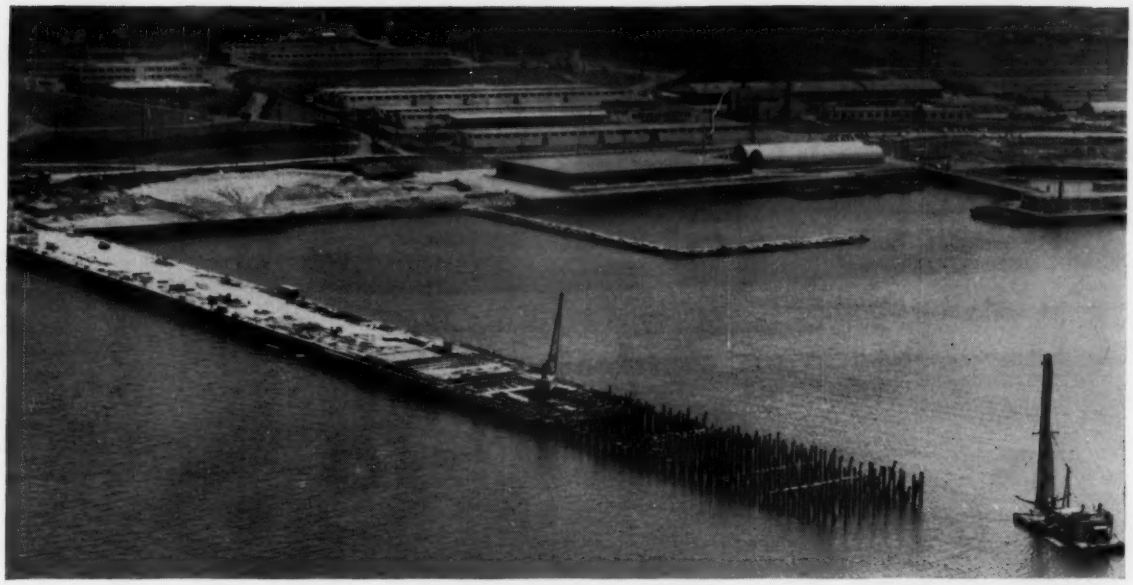


FIG. 3. (Corrected) Magnitudes of base shear forces, expressed as percentages of total weight of building, are compared. (Note that bar for UBC value has been corrected.)

well as its height and period of vibration, should be taken into consideration in specifying the manner in which the shear forces are to be distributed.

It is fortunate that the paper by Messrs. Tung and Newmark (referred to in Mr. Binder's letter) has been published at this time, thus emphasizing the effects of type of building construction on the shape of the shear envelope.



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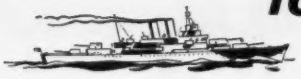

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The Readers Write . . .

(*Continued from page 100*)

Second, the observation in my article regarding the relative conservatism of the Uniform Building Code and the proposed code of the Joint Committee (JCC) should be modified. Although the UBC gives a base shear coefficient which is still 60 per cent greater than that of the JCC, this difference is quite insignificant when compared with the differences between theory and both codes. The relative merits of the two codes should not be decided on the basis of this rather slim margin of difference.

I wish to thank Mr. Binder and others for calling this error to my attention.

RAY W. CLOUGH, A.M. ASCE
Assoc. Prof. of Civil Eng.,
Univ. of Calif.
Berkeley, Calif.

Show us where we're going

TO THE EDITOR: Undergraduate engineering students are confronted with a problem that has not been properly emphasized. In plain English, the average student doesn't know what a person in his field really does when he graduates.

One student registers in a certain branch of engineering because his Uncle John was in it. Another takes civil engineering because he would like to be out of doors. Some students may switch curricula or drop out of college entirely as a result of a poor choice.

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If the student were better informed as to the actual types of work a civil, electrical, or mechanical engineer performs, he would be in a better position to select the branch he wants to follow. The student should also be encouraged to seek summer employment with a firm doing some type of engineering work, as this also would help him to determine the field of engineering best suited to him.

H. WALTER ANDERSON
Member, ASCE Student Chapter
Montana State College
Bozeman, Mont.

(*End*)

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DECEASED

Clinton T. Bissell (M. '14), age 83, an engineer with the National Board of Fire Underwriters from 1909 until his retirement two years ago, died February 15 at his home in Montclair, N. J. Mr. Bissell received a degree in civil engineering from Yale University in 1897 and was a resident engineer with the Long Island Railroad and the Brooklyn Heights Railroad Co. from then until 1909. His work with the National Board of Fire Underwriters dealt with investigation of structural conditions which might become fire hazards.

A. Burton Cohen (M. '24), age 73, consulting engineer of East Orange, N. J., died in a New York hospital on February 11. Mr. Cohen was a specialist in the design of concrete bridges and the elimination of railroad grade crossings. In private practice since 1920, Mr. Cohen prepared the contract plans for seventeen bridges on the New York Thruway and for eleven spans on the Connecticut Turnpike. He did grade-crossing elimination work for Nassau County (New York), various Eastern railroads and municipalities, and the New York State Department of Public Works. A graduate of Purdue University, class of 1905, Mr. Cohen obtained his civil engineering degree from Purdue five years later. He was the author of many articles on design and construction of concrete bridges, and in 1926 received the Wason Medal of the American Concrete Institute for his achievement in solving bridge problems.

Cuthbert P. Conrad (M. '25), age 62, retired Commodore, U. S. Navy and chairman of the board of the Iowa-Illinois Gas & Electric Co., died at his home in Davenport, Iowa, on January 24. Mr. Conrad had an outstanding record in utility management, having spent fifteen years in Brazil as chief hydraulic engineer with the Brazilian Traction Light and Power Co., during the period of greatest development of the Sao Paulo area. He served in the Navy Civil Engineer Corps in both World Wars, and in the recent war directed the entire Advance Base Department in support of the Seabees construction work in the Pacific and elsewhere. In 1946, Mr. Conrad joined the Iowa-Illinois Gas & Electric Co. as president, becoming chairman of the board in 1954. He was a graduate of the University of Wisconsin.

Nathan B. Jacobs (M. '24), age 64, prominent Pittsburgh consultant and president of the engineering firm of Morris Knowles, Inc., of that city, died in Philadelphia on February 14. He was fatally stricken in Harrisburg, where he had gone on a business trip, and removed to a hospital in Philadelphia. Mr. Jacobs was widely known as a sanitary engineering consultant, civic leader, and

(*Continued on page 106*)

from "Chicago"

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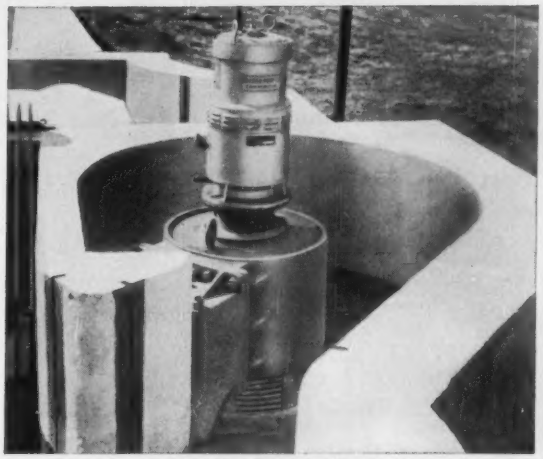
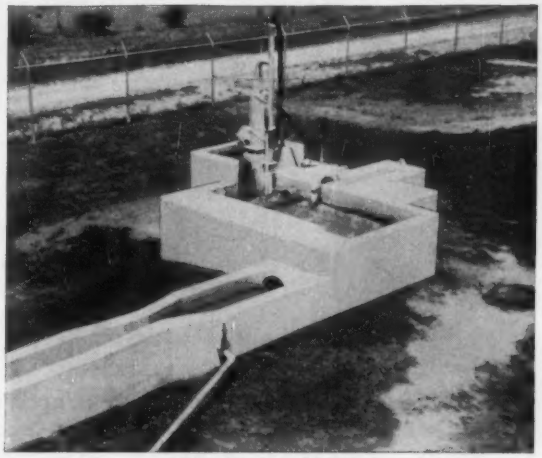
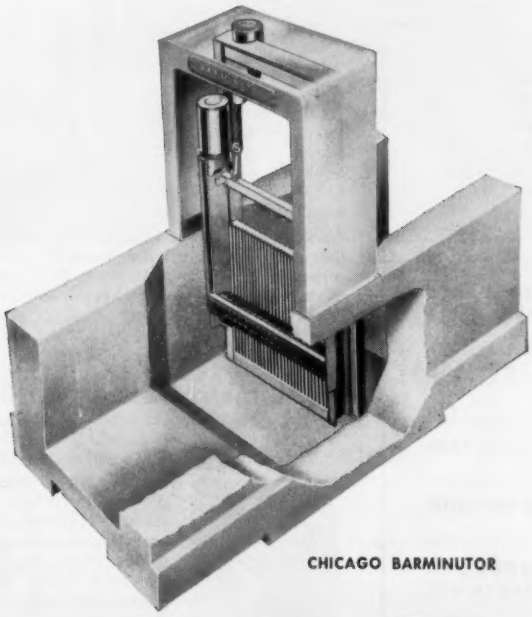


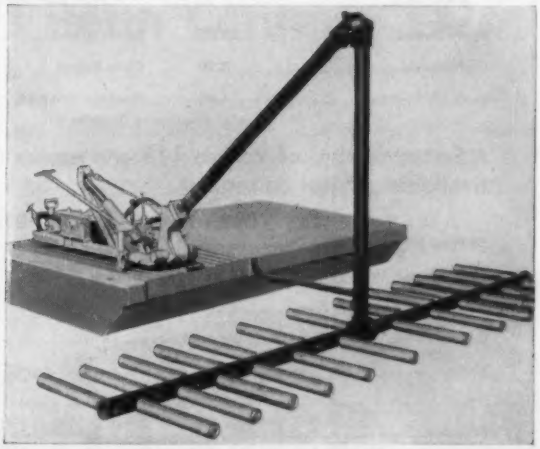
CHICAGO COMMINUTOR



CHICAGO AER-DEGRITTER



CHICAGO BARMINUTOR



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Because of the urgent need to return the structure to service as quickly as possible, Cement Gun Company used four guns simultaneously throughout the restoration work. Construction joints were repaired and reinforced "GUNITE" lining placed over entire bottom and sides.

The relining of this 20 million gallon reservoir is a typical example of the many jobs performed quickly and economically by Cement Gun Company for municipalities and privately owned Water Companies throughout the United States.

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Deceased

(*Continued from page 104*)

philanthropist. He specialized in municipal engineering. Mr. Jacobs was a graduate of the University of Pittsburgh.

James Houstoun Johnston, Former Director, Dies

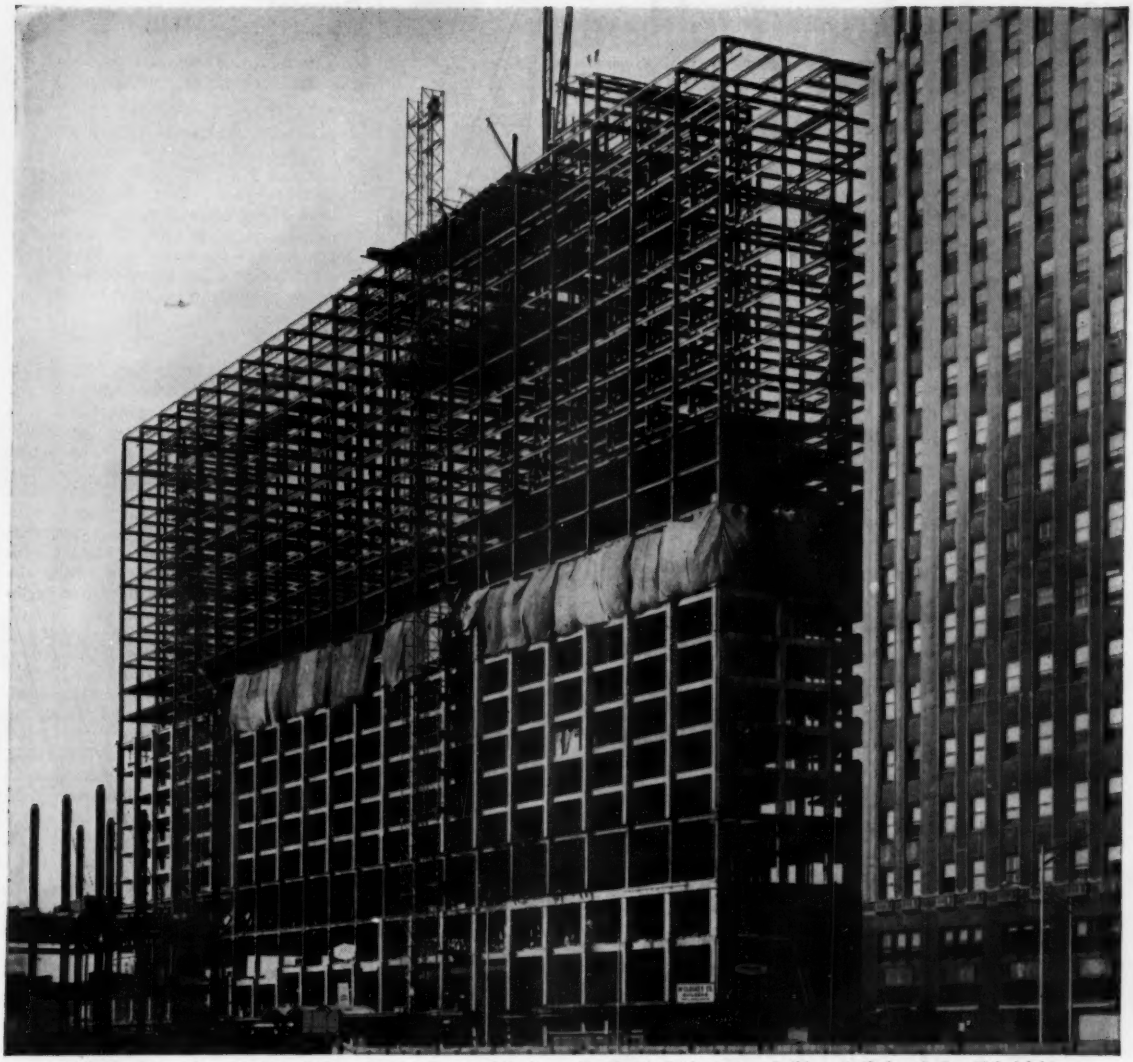
James Houstoun Johnston (M. '17), age 89, retired civil engineer of Atlanta, Ga., died there on February 7. A specialist in railway valuation engineering, Mr. Johnston served the Louisville & Nashville, the Illinois Central, and the Savannah & Atlanta railroads for more than thirty years. He was also consulting engineer for the Georgia Public Service Commission for several years and, from 1915 to his retirement at the end of World War II, special engineer to Georgia on valuation of the state-owned Western & Atlantic Railroad. From 1933 to 1937 he served as state engineer and acting director for the PWA. Active in the Society, Mr. Johnston was president of the Georgia Section in 1924 and ASCE Director from 1928 to 1930. His alma mater, the University of the South, gave him the honorary degree of doctor of science in 1946.

Harrison Wainwright Latta (M. '05), age 84, retired civil engineer of Philadelphia, Pa., died there on January 5. A graduate of the University of Pennsylvania, class of 1890, Mr. Latta received his C. E. degree from the same university the following year. As president of the Latta & Terry Construction Co. from 1902 to 1915, Mr. Latta built electric railways. From 1917 until his retirement he was a member of the firm of Latta & Roberts. His important projects included construction of the concrete sea wall at the Naval Academy at Annapolis and of breakwaters in Delaware Bay for the U. S. Army.

Norris Matthews (A.M. '52), age 34, resident consulting engineer with the New York firm of Tippetts, Abbett, McCarthy and Stratton, was one of three ASCE members killed in a plane crash near Baghdad, Iraq, February 6 (see pages 108 and 110). A graduate of Columbia University, class of 1943, Mr. Matthews served in the Navy for three years. He joined Knappen, Tippetts, Abbett and McCarthy in 1947 as hydraulics, hydrology, and specifications engineer, and at the time of his death was working on an

Norris Matthews

(*Continued on page 108*)



Architect: Perry, Shaw, Hepburn & Dean, Boston. *Structural Engineer:* Maurice A. Reidy, Boston. *Builder:* McCloskey & Co., Philadelphia.

Steel rises for new 22-story hotel in Philadelphia's Penn Center

When this photograph was taken, late last year, Bethlehem erection crews had just topped out steelwork for Philadelphia's new Sheraton Hotel. A newsmaker in two respects, it is the first hotel to be built in Philadelphia in over a quarter-century, as well as the city's first structure to be erected with high-strength bolts.

Centrally located in the mid-city Penn Center development, the 22-story Sheraton will provide 1,000 guest rooms. One floor, the twenty-first, will be entirely given over to balconied luxury suites. Public rooms will occupy the three lower floors. Parking for guests' automobiles will be handled in an 800-car garage just across Pennsylvania Boulevard, and easily reached by an underground concourse. Also on the concourse level is a bus terminal and retail shops. Owner of the hotel is the Sheraton Corporation of America.

Bethlehem fabricated and erected 3,900 tons of steel for the hotel's framework. Erection was speeded by the use of about 87,000 high-strength structural bolts, authorized by a recent amendment to the local building code.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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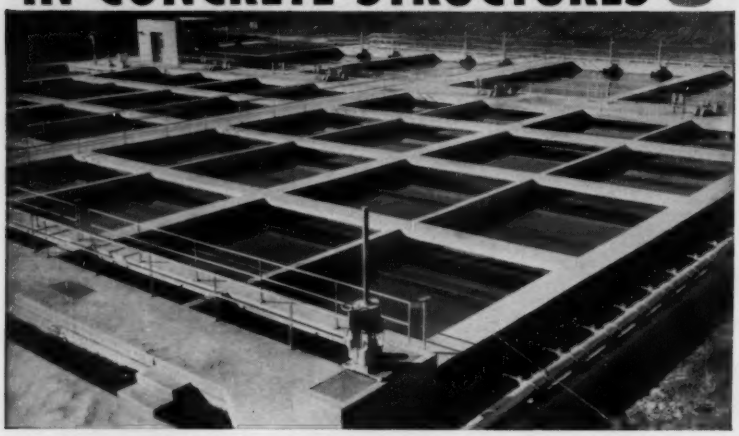
Water Leakage Problems IN CONCRETE STRUCTURES?



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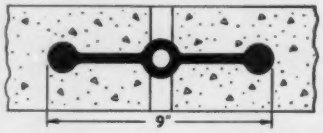
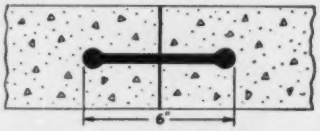
Insures permanent, watertight seals in joints where considerable movement due to expansion and contraction is expected. Flexible and elastic with a very high degree of tensile strength to withstand both lateral and shearing movement. Widths—6" and 9" . . . lengths to order.



FLAT DUMBBELL—FOR CONTRACTION OR EXPANSION JOINTS

Made of durable, elastic cured rubber which has high tensile strength and flexibility for effective sealing of contraction and expansion joints against hydrostatic pressure. Carefully manufactured to insure dense, homogeneous cross section for greatest service life. Widths—6" and 9" . . . lengths to order.



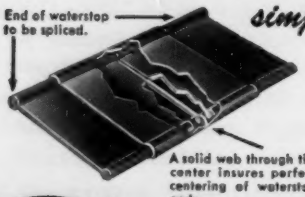
SPLIT TYPE WATERSTOP

faster, easier installation

A new Servicised development already in wide use because it reduces installation time and cost by eliminating splitting of form. One half of width is split to permit fastening to inside of bulkhead in the form of a "T." After section is poured, form is removed and divided sections are joined together by stapling. Pat. Pend.

WATERSTOP UNION

simplifies Field Splicing



Permits a faster, simpler method of field splicing, using only rubber cement. The union is hollow and is made from rubber meeting the same specifications as the waterstop. Available for splicing 6" and 9" Dumbbell and 6" and 9" Hollow Bulb Waterstops. Pat. Pend.

Write for Special Waterstop Catalog.

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6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

Deceased

(*Continued from page 106*)

irrigation project his firm was building for the Iraq Government.

Joseph N. McKernan (A.M. '13), age 74, secretary-treasurer of the Plainville Water Co., Plainville, Conn., for the past forty-three years, died there recently. A graduate of Massachussetts Institute of Technology, class of 1906, Mr. McKernan had also been town engineer since 1913. He did much of the municipality's work on storm water sewers, street layout, and pipe lines.

Harold Eugene Miller (M. '50), age 50, of Denver, Colo. and chief engineer for the Iraq Government Development Board on loan from the United States Foreign Operations mission, was killed in a plane crash near Baghdad, Iraq, on February 6, with two other members of ASCE. Mr. Miller was with the U.S. Bureau of Reclamation for twenty years in various important capacities, and served during World War II as Lieutenant Colonel, in the U. S. Army General Staff Corps. More recently he had been in Athens, Greece, on the design of dams and irrigation structures, to be constructed in cooperation with the ECA. He was a graduate of the University of Kansas.

Harold E. Miller

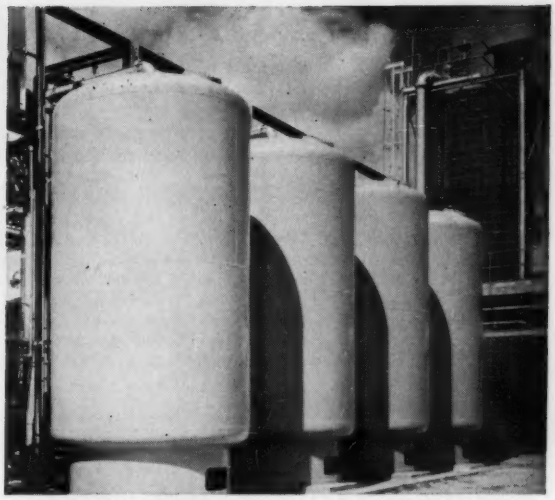
John R. Noyes (M. '50), age 53, retired Brigadier General, U. S. Army Corps of Engineers and Adjutant General of the Alaska National Guard, died at Nome, Alaska on January 30 as the result of injuries received when the plane in which he was making an inspection trip crashed. A graduate of West Point, class of 1923, he received a civil engineering degree from Cornell University in 1926. General Noyes served in the Engineers and Transportation Corps for 30 years, including two tours of duty in Alaska. As head of the Alaska Road Commission from 1948 to 1951, he supervised the modernization of much of the territory's new highway system. Retiring in 1953, he was appointed Adjutant General of the Alaska National Guard a few months later.

John R. Noyes

Albert E. Pohmer (A.M. '30), age 57, engineer and land surveyor of Baltimore, Md., died recently. A graduate of Baltimore Polytechnic Institute, class of 1916, Mr. Pohmer had a consulting practice for the past seventeen years. He worked for the J. Spence Howard firm of civil and consulting engineers as assistant to Mr.

(*Continued on page 110*)

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



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• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.

• **Manufacturing** – After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

• **Test runs** – Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. C-4, 5500 Royalmount Ave., Montreal 9, Que.

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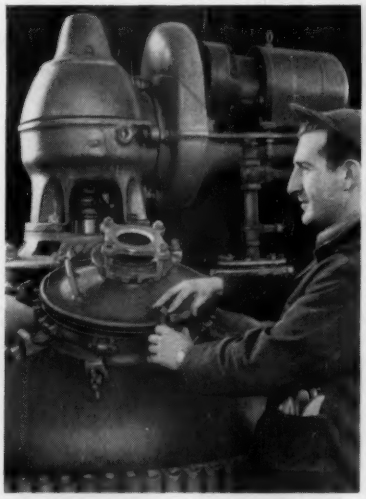
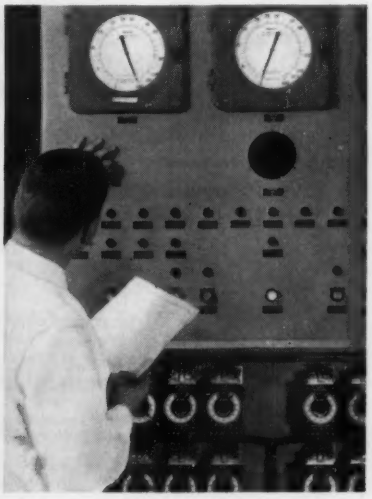


ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

Deceased

(*Continued from page 108*)

Howard on all types of survey work and as resident engineer on railroad construction for 14 years. Mr. Pohmer served in the U. S. Army in World War I.

Adolph J. Post (A.M. '17), age 67, chief sanitary engineer for the Boston Public Works Department, died at his home in West Roxbury, Mass., on February 12. A graduate of Harvard University, class of 1910, Mr. Post entered the service of the city of Boston upon his graduation. He carried out many specialized investigations for the city, including a traffic survey and study of street design. He was the author of numerous articles in the field of public engineering. In the Construction Division of the Army in World War I, he set up a public works department for Camp Devens.

Lloyd M. Salisbury (A.M. '32), age 66, retired engineer, died at his home at Montville, N. J., on February 1. For more than twenty-five years Mr. Salisbury was construction engineer for the Equitable Life Assurance Society of the United States, with headquarters in New York. He retired two years ago. In his early career he was research engineer for the Minnesota State Highway Commission and designer for the Public Service Production Co. He was a graduate of the Sheffield Scientific School of Yale University and a veteran of World War I.

Gabriel R. Solomon (M. '13), age 75, retired consulting engineer of Troy, N. Y., died at his home there on February 16. He was a civil engineering graduate of Rensselaer Polytechnic Institute and a law graduate of Mercer University at Macon, Ga. Under the firm name of Solomon, Norcross, Co., and later Solomon, Norcross and Keis, Mr. Solomon engaged in general engineering practice in Atlanta, Ga., Fort Lauderdale, Fla., and Troy, completing important building projects in twenty-three states, Canada, and Cuba. From 1924 until his retirement in 1943 he was in active practice in Troy as a member of the firm of Solomon & Keis. A veteran of World War I, in which he attained the rank of lieutenant colonel, Mr. Solomon was architect-engineer in World War II on several large army camps, an overseas airbase, and other important war installations.

William Sherman Tanner (M. '47), age 60, member of the firm of Butler & Tanner, Sacramento, Calif., died there recently. A native of Texas, Mr. Tanner served for sixteen years as an engineer with the City of Dallas. He was in private practice in Los Angeles for many years, and city engineer of North Sacramento, Calif., for three years. A graduate of Southern Methodist University with the degree of civil engineer, Mr. Tanner served in the U. S. Army in World War I.

Charles French Travis (M. '52), age 48, special partner in the New York firm of consulting engineers, Tippetts, Abbett, McCarthy and Stratton and its regional manager in the Middle East, was one of the three ASCE members killed February 6 in a plane crash at Baghdad, Iraq. He was with the U. S. Engineer Office for ten years at the Memphis, Tenn., Zanesville, Ohio, and New York offices. During the war he served in the U. S. Army Corps of Engineers with the successive ranks of captain, major, and lieutenant colonel. For some years Mr. Travis was with Parsons, Brinckerhoff, Hall & MacDonald as associate engineer in Brazil, Venezuela, and Ecuador. He had been associated with Tippetts, Abbett, McCarthy and Stratton for the past nine years. Mr. Travis graduated from New York University with a civil engineering degree in 1941.

Samuel Weishoff (M. '42), age 65, consulting structural steel engineer and a partner in the firm of Weinberger, Weishoff, Leichtman & Quinn, New York City consulting engineers, died there at his home on January 12. Mr. Weishoff was a civil engineering graduate of Cooper Union, class of 1914. He worked for John Chapman, construction engineer of New York City, for four years and in 1918 went into private practice as consulting engineer and designer. In 1923 he entered the partnership of Weinberger & Weishoff, which did structural steel design work for many important structures here and abroad.

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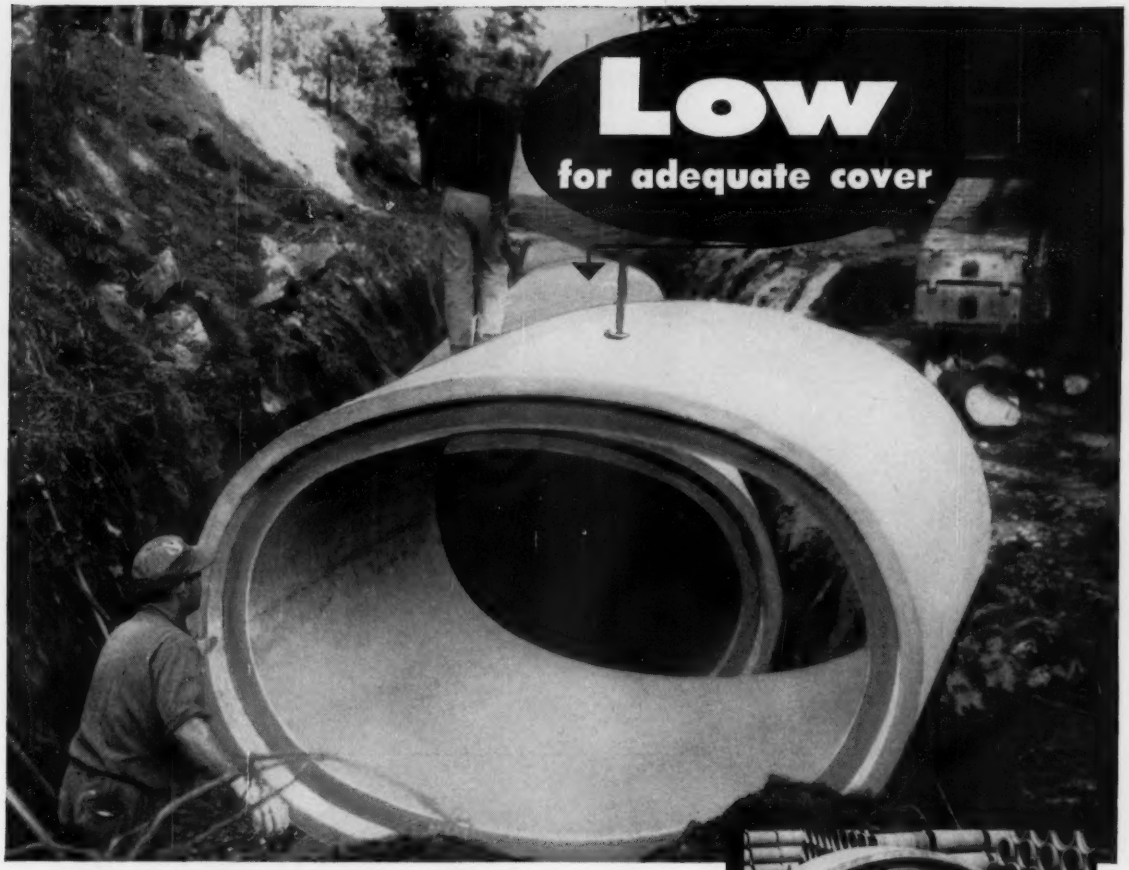

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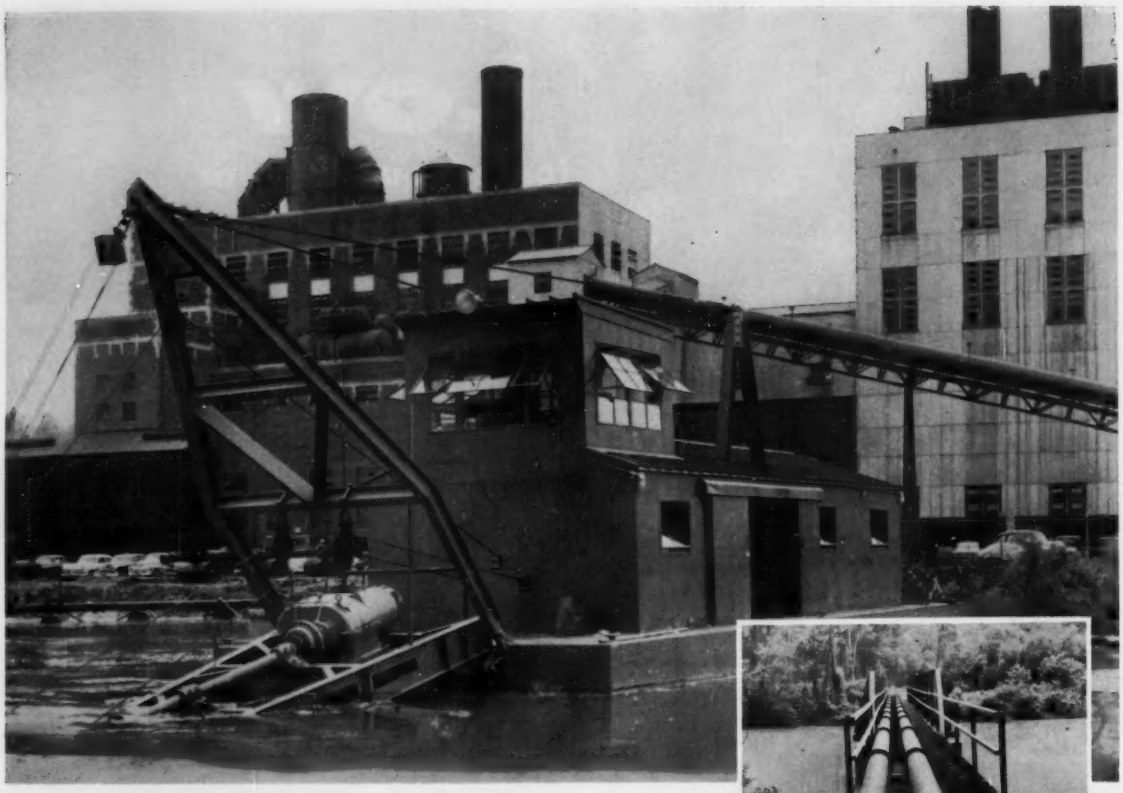


American Double-X Mechanical Joint Pipe was laid over this canal on a bridge.

Over a canal, under a river, into a lake...

American Cast Iron Pipe

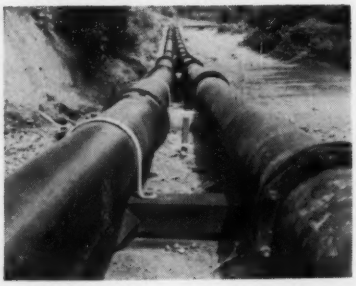
Mix ashes and water and you get an abrasive slurry. Push it through ordinary pipe at high speed and you get fast wear...

Ash disposal creates a problem at every coal-fired steam generating plant. American Cast Iron Pipe Company service helped in an unique solution to this problem at one plant.

Here, ashes are discharged from the plant into a small nearby lake for temporary storage. A floating hydraulic dredge on this lake then pumps the mixture of ashes and water through American Pipe to another lake for permanent storage. This lake, built in a hollow which will provide adequate storage space for twenty years, is retained by a porous dam. Water drains out; ashes remain.

The American Pipe used in the land lines of this installation is heavy wall, abrasion-resistant alloy cast iron pipe with Double-X Mechanical Joints. For the river crossing, Molox Ball Joint Pipe was used.

There is an American Cast Iron Pipe designed for your exact purpose—long-lasting, economical, trouble-free pipe. Specify *quality* pipe, centrifugally cast—American Cast Iron Pipe.



These 12-inch Double-X lines, conducting a mixture of ashes and water to a storuge lake, connect to Molox Ball Joint Lines laid under a river.

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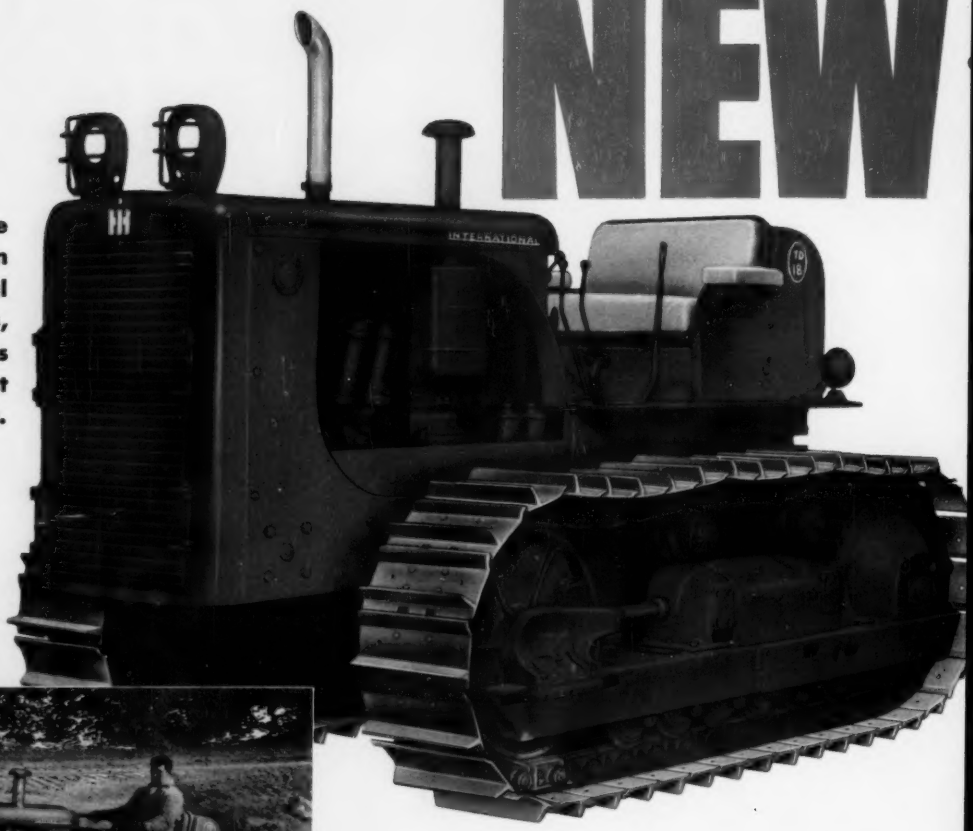
124 Net Engine Horsepower. In International Drott Machines, Engine develops 134 Net Horsepower.



182 Series

TD 18

TD-18 diesel (series 182) delivers 103 drawbar horsepower, with weight of 29,050 pounds (without equipment). All-weather electric starting, standard equipment. "New look" visibility, operating ease never before available. New heavy-duty, swinging-door type radiator guard is "standard"—for carrying heavy front-mounted equipment. Gives big tractor performance in pioneering under roughest conditions. Powers 3-yard International Drott Skid-Shovel, anywhere.

No costly delay from a "killed" or cold engine—you start fast! Famous International *gasoline-conversion* diesel starting—*actual* "in-seat" starting—is *standard equipment* on this new crawler line. With "push-button" ease, you get seconds-fast starting, whether the engine is cold, or stopped! And you're on the job seconds-fast, when minutes are dollars.

Cerametallic Engine Clutch Facings Save power, defy heat, prolong life! Uncomplicated, *familiar-to-all* engine clutch design of these new crawlers have *power-holding, heat-defying, long-lasting* Cerametallic facings. These facings reduce lever-pull up to 50%, provide amazing heat immunity, add service freedom, cut upkeep!

Now . . . 500-hour lube intervals with new metal-to-metal, track roller seals! You save the time and expense of frequent inspections or lubrications, with the new *full-floating*, cartridge-type, track roller seals provided on the TD-24, TD-18, and TD-14. These precision-lapped, metal-to-metal seals are so effective they give you *safe* 500-hour intervals between roller lubrications!

Steps up a size... in job range and capacity!

50 Net Engine Horsepower. In International Drott Machines, Engine develops 55 Net Horsepower.

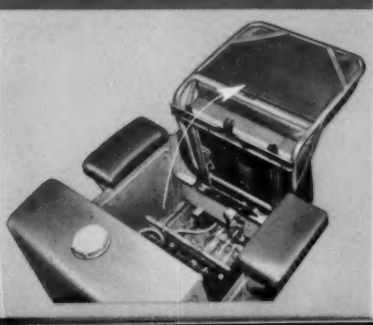
61 Series

TD 6

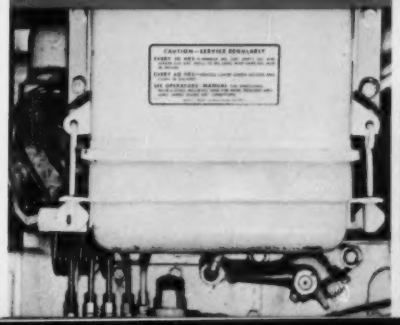
TD-6 diesel (series 61), 41.5 drawbar hp, up 23%! Steps up a whole size in work capacity and earning ability. Operating weight (5-roller model), without equipment, 8,890 pounds. Powers 1-yard International Drott Skid-Shovel or Four-In-One; serves as clean-up dozer unit on any-sized contract; versatility and low operating cost to do many sizes of jobs for every size of contractor.

Full-view, one-glance panel saves time—cuts effort! One quick glance at this new full-view panel, with centralized instrument grouping, gives the operator the instant check-up, to assure that lubrication, generator, and cooling system are "perking" for full production!

New Fold-over Seat Aids Fast, Centralized Servicing! New fold-over seat of the TD-6 and TD-9 models allows operator to give you the time and convenience advantages of centralized steering clutch assembly servicing. Lubricant fittings are conveniently grouped and fully accessible!



Thorough air filtration assured by new under-hood cleaner! Instead of being "in your lap," or a knee-bumping obstruction, air cleaners of the new International crawlers are side-mounted—for easy accessibility, yet out of the way. They have big capacity and high efficiency, too, for positive air filtration!



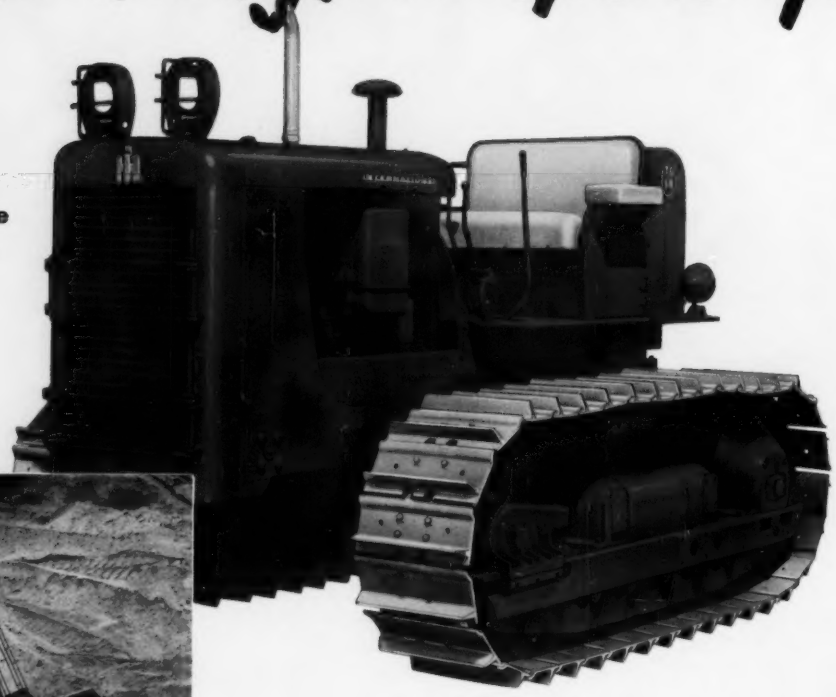
International® Crawlers *give*

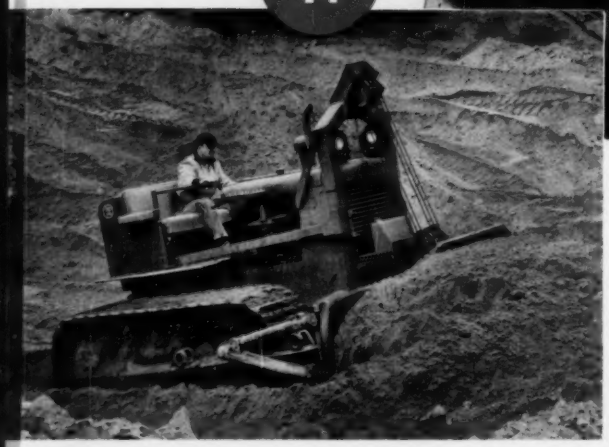
plus new design to speed you

95 Net Engine Horsepower.

142 Series

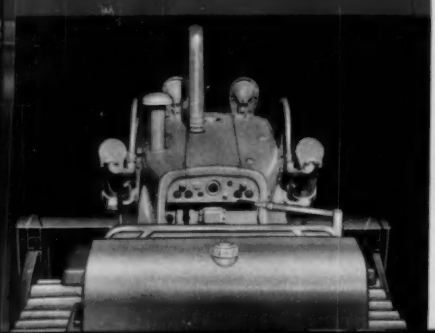
TD 14



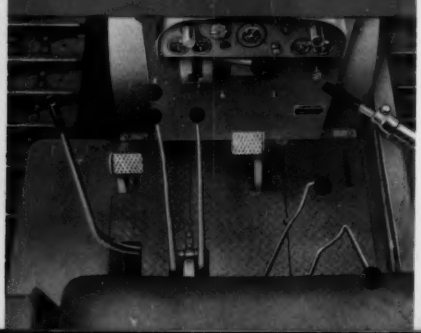


TD-14 (series 142), 78.5 drawbar hp; weighs 21,095 pounds (without equipment). Features "new look" engineering, job-speeding visibility, new equipment-carrying and operating strength. All-weather electric starting, standard equipment. It's a fast, responsive, big-capacity dozing tractor. Powers 2¼ cu. yd. International Drott Skid-Shovel or Four-In-One; 15-ton capacity Superior Pipe-Boom; other similar-sized equipment.

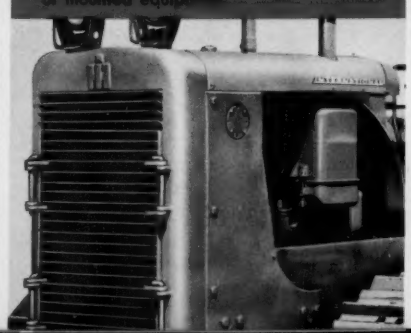
Control Power Visibility adds operating efficiency! See how new International crawlers are streamlined for complete job-control visibility. Seat is amply high to provide full view of equipment, terrain, and variations requiring operator action, to maintain efficiency.



Clean, safe deck cleared for action! Look down on that safe, clean, flush deck—a platform for full production. The wide, man-size seat is fully-adjustable; foam rubber padded. Instruments centralized for one-glance check-up! Even a cigarette lighter is provided, to prevent needless steps!



Pressurized Closed Cooling System for Positive Performance Protection! New pressurized cooling systems provide fast warm-up under thermostatic control—and positive *ideal* temperature control with forced circulation through full-length jackets. That aids clean combustion, guards oil film strength, protects performance. Radiator core assembly is easily-removable, without disturbing radiator guard or mounted equipment.

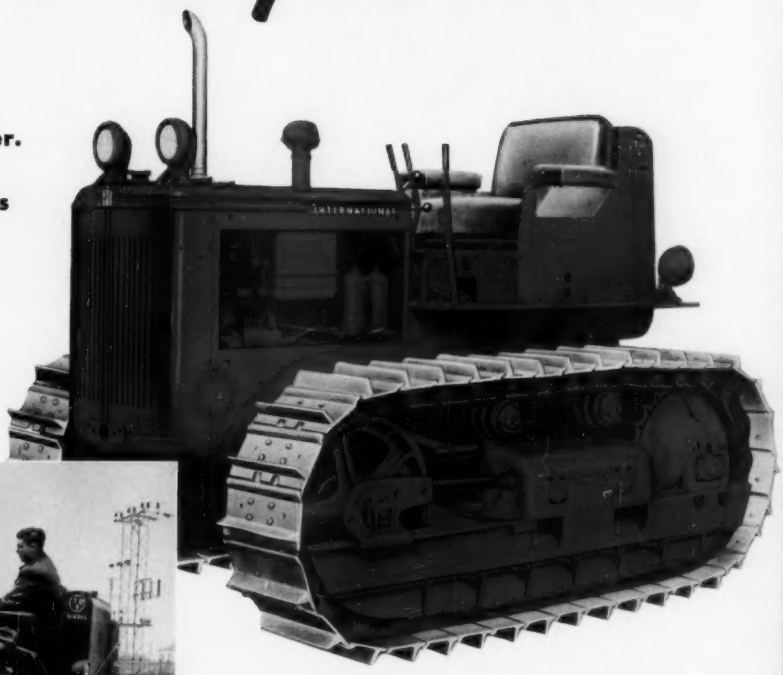


ive you Bonus horsepower—
our jobs, control your costs!

66 Net Engine Horsepower. In International Drott Machines, Engine develops 71 Net Horsepower.

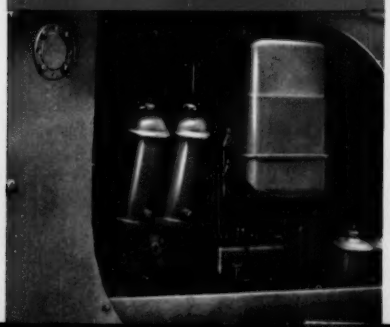
91 Series

TD 9



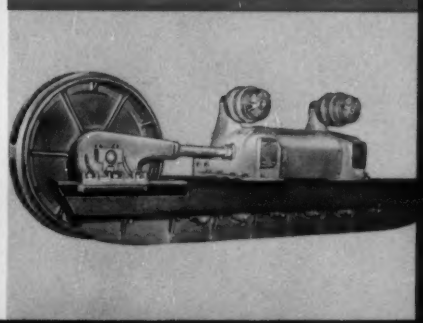
TD-9 diesel, (series 91), delivers 54.5 drawbar hp—up 32%. Operating weight (5-roller model), without equipment, 12,000 pounds. Now up in a new heavy-duty job range. New power is backed by new power train and track frame strength, new operating and servicing ease. Powers International Drott 1½ cu. yd. Skid-Shovel and other equipment requiring similar power.

480-hr. full-flow lube oil filters guard bearings, cut upkeep! Every drop of oil on its way to lubricate moving engine parts must pass through these new abrasive-trapping micron-type filters—with the capacity, strength, and efficiency to give 480 hours of wear-fighting, upkeep-cutting duty!



Hydraulic Power Steering Inspires Operator Cooperation! New hydraulic power steering of the TD-14 and TD-18 cuts operator fatigue—and along with the other big effort-saving advantages, makes it easier than ever to deliver full-capacity production! TD-6 and TD-9 have spring boosters to lighten the operator's job.

"Bridge-strong" track frames for "slam-bang" conditions! You are looking at the strongest track frame in the industry for crawlers of TD-18 and TD-14 size! Heavy steel box-section beams, weld-joined to heavy stress-relieved steel plates—and rigidly gusset-braced—they're your foundations for record-making "rough-and-tumble" performance!



TD 24

The capacity leaders in their power class

Gear Drive Model, 190 Net Engine Horsepower
Torque Converter Model, 200 Net Engine Horsepower

Massive—with 43,080 pounds of rock-dozing, scraper-pushing brawn (7-roller torque converter model)*—the TD-24 can give them all a lesson in operating ease, big capacity, and positive load control! Has instant high-low range and exclusive Planet Power steering to give you its tremendous *pushing*, *pulling*, and *lifting* power on any terrain—with responsiveness not available elsewhere! *Live power on both tracks, on every turn!* Backed by equipment engineered to match its strength and power!

*Gear Drive 7-roller model weighs 42,780.

New International Attachments and Equipment team with new bonus-powered crawlers to give you high-producing performance packages: 42 new Bulldozers, to fit your needs exactly . . . 4 new Drott Loaders, 1 to 3-cubic yard capacity . . . 4 new Superior® Pipe-Booms, 8 to 55-ton capacity; 3 job-proved PCU'S! . . . **Measure . . . compare . . . prove to yourself . . . new bonus-powered International crawler tractors beat anything else on tracks! Try this turnpike-paced new power for capacity, operator preference, profit potential. Ask your International Industrial Power Distributor for a bonus-powered demonstration *to your specifications!***

INTERNATIONAL HARVESTER

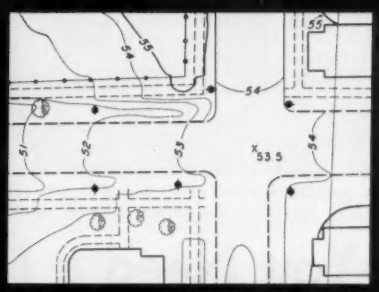
International Industrial Power

INTERNATIONAL HARVESTER COMPANY, 180 N. Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Tractor and Rubber-tired Loaders . . . Diesel and Carbureted Engines . . . Motor Trucks.

The sky's the limit . . . when we tackle your mapping problems

For stereoscopic study and reconnaisance; area study, planning and location.



For tax valuation and study, industrial site location, annexation, zoning and traffic control.

For design and location of highways, streets, bridges, sewage-disposal plants, flood control, waterways, utilities and public works projects.

Terrain or location is no problem when you rely on the aerial mapping service of Jack Ammann Photogrammetric Engineers, Inc. No place is too distant — too inaccessible — or too rugged for Ammann crews to operate in and still deliver precision maps on schedule.

Ammann maps produced by the latest photogrammetric methods not only meet the most exacting engineering specifications, but they are produced at big savings both in time and money. Weeks and sometimes months are saved over conventional ground survey methods.

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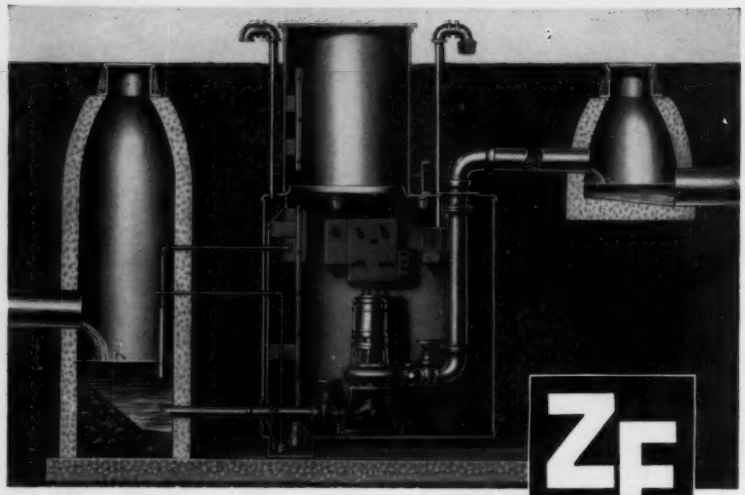

This prefabricated unit, the Z-F Underground Pumping Station is the answer to most applications

Do You Need a Lift Station?

- Installation can be made with a minimum of time and cost.
- Can be installed on existing public property.
- Entire unit is prefabricated and shop-fitted with standard, well-known equipment.
- Usually can be located at most advantageous spot for existing gradients.
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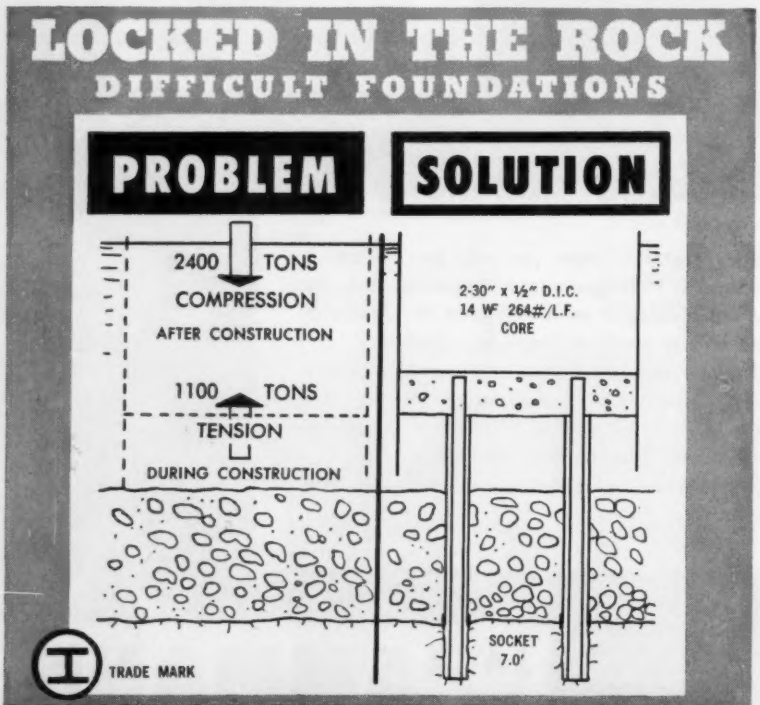
- Improved equipment, controls and prefabricating technique make the Z-F Station an economical and reliable unit. Write for details. (Territories open for representatives)

Manufactured by ZIMMER & FRANCESCON, Moline, Illinois

LOCKED IN THE ROCK
DIFFICULT FOUNDATIONS



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RECENT BOOKS

Construction Planning, Equipment and Methods

The purpose of this book is to show how the application of engineering fundamentals and methods of analysis can improve the quality of construction while at the same time reducing costs. The subjects covered include job planning, construction management, factors affecting equipment selection, and such fundamentals as soil compaction, the effect of altitude and temperature on engine performance, rolling resistance, etc. Considerable space is devoted to the performance, cost, and suitability of various kinds of equipment, and to drilling, tunneling, foundation grouting, and other procedures. R. L. Peurifoy is the author. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36. 534 pp., $8.50.)

Der Einfluss des Kriechens und Schwindens in Spannbeton-Konstruktionen

A mathematical analysis by W. Säger of the influence of creep and shrinkage in prestressed concrete structures. The material covers both determinate and indeterminate structures, and the general subject of creep of concrete under load is surveyed. (Werner Verlag, Düsseldorf, Germany, 1955. 175 pp. DM. 13.20.)

Distribution of Lateral Forces in Small Buildings

Lawrence A. Briggs and Oscar M. Bloch are the authors of a presentation of a method of distributing lateral forces, whether earthquake or wind, into the resisting piers or walls. The subjects treated include determining forces, how elements of a structure resist forces, the proportion of the force resisted by each pier, wall rigidities, rotational analysis, and walls normal to force. Three chapters are devoted to analyses of a small wood frame structure, a similar structure of concrete, and a three-story structure. (Briggs Publishing Co. P. O. Box 351, Glendale 5, Calif., second edition, 1955. 89 pp., $3.00.)

Professional Engineer's Examinations—Questions and Answers

Eighty per cent of the 500 problems in this book by William S. LaLonde, Jr., have been taken from past examinations given in many states; the remainder have been added to give better coverage of some subjects. The questions have been selected to represent all the major phases of examinations for professional engineers and engineers-in-training, and the answers are given in the detailed form acceptable to examiners. General information on registration, experience qualifications, etc., is included in an introductory section. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36. 462 pp., $6.50.)

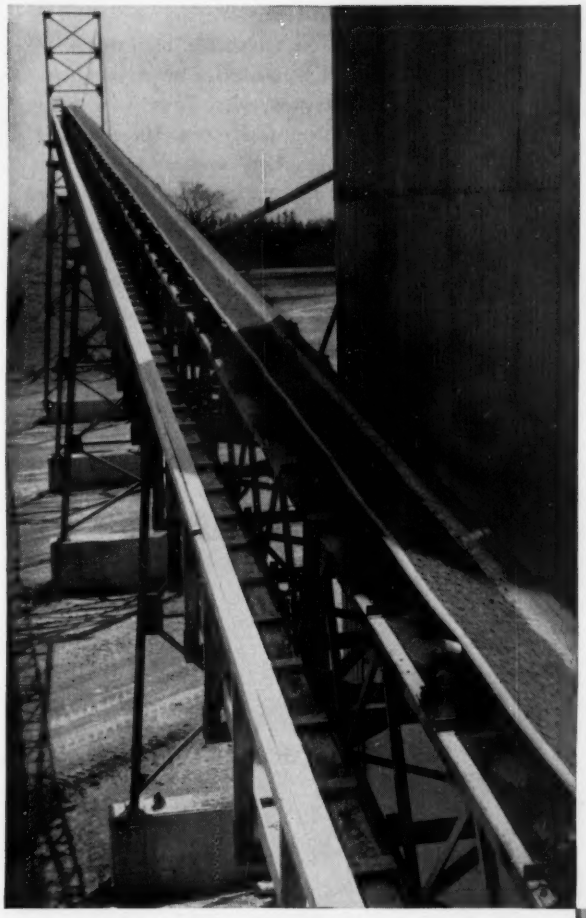
Standard Specifications for Highway Materials and Methods of Sampling and Testing

Part I of this compilation by The American Association of State Highway Officials, includes 100 specifications for hydraulic cements, bituminous materials, soils, aggregates, brick, culvert and sewer pipe, bridge paints, and other materials. Of these, 45 have been revised and eight adopted since the previous edition was published in 1950. The second part contains 140 methods of test in their latest form. In cases where standards of the Association are identical in content to ASTM standards, ASTM designations are given. (The American Association of State Highway Officials, 917 National Press Building, Washington, D.C., Seventh Edition. 257 pp., 2 bound volumes. $7.50.)

(*Continued on page 124*)

All costs considered -- belt conveyors by LINK-BELT are your most effective means to

GREATER TON-MILE ECONOMY



Efficient, economical handling of bulk materials is provided by this 260-ft. Link-Belt conveyor with 24-in. wide belt. These conveyors can travel up or down grades as steep as 32%.

For large or small systems -- you get unrestricted selection of components and unmatched engineering background

CONTINUOUS operation, large capacity, flexibility, ease and infrequency of maintenance — belt conveyors offer many advantages unmatched by any other kind of bulk material transportation. And when they're supplied by Link-Belt, you enjoy additional benefits through unbiased choice of components and vast engineering experience.

Link-Belt equipment includes a complete line of idlers, trippers, drives, terminal machinery and other items. We can recommend the most practical combination for your particular job, with all elements having correct-rated capacities.

As for experience, Link-Belt is qualified by scores of installations in every industry. In fact, Link-Belt has been a pioneer in the development of belt conveyors for long or short hauls, indoor or outdoor service. As a result, our recommendations are based on methods proved successful in applications similar to yours.

Your Link-Belt office will gladly fill in details on how belt conveyors can lower your handling cost per ton-mile. Call today.

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.900

Bearings, drives, supports and enclosures as required in this installation are also made by Link-Belt. Availability of all elements from one source saves delays and complications.

You play safe when you lay

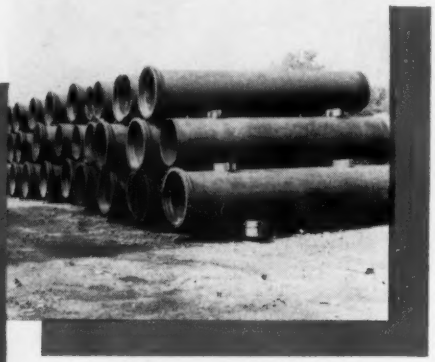
River crossing of cast iron pipe line to carry sewage to disposal plant at Portland, Oregon.

Installation of mechanical joint cast iron pipe for gas distribution at Syracuse, Nebraska.

Cast Iron pipe has long been recognized throughout the engineering profession as a rugged and adaptable material with proved ability to survive beam, compressive and shock stresses. Today's *modernized* cast iron pipe—centrifugally cast—is even tougher, stronger and more uniform in quality. Its effective resistance to corrosion, plus high strength factors, ensure long life with minimum maintenance cost. Yes, you play safe when you lay cast iron pipe—from your own standpoint and that of the taxpayers you serve. For further information, write Cast Iron Pipe Research Association, Thomas F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Illinois.

CAST Q IRON®

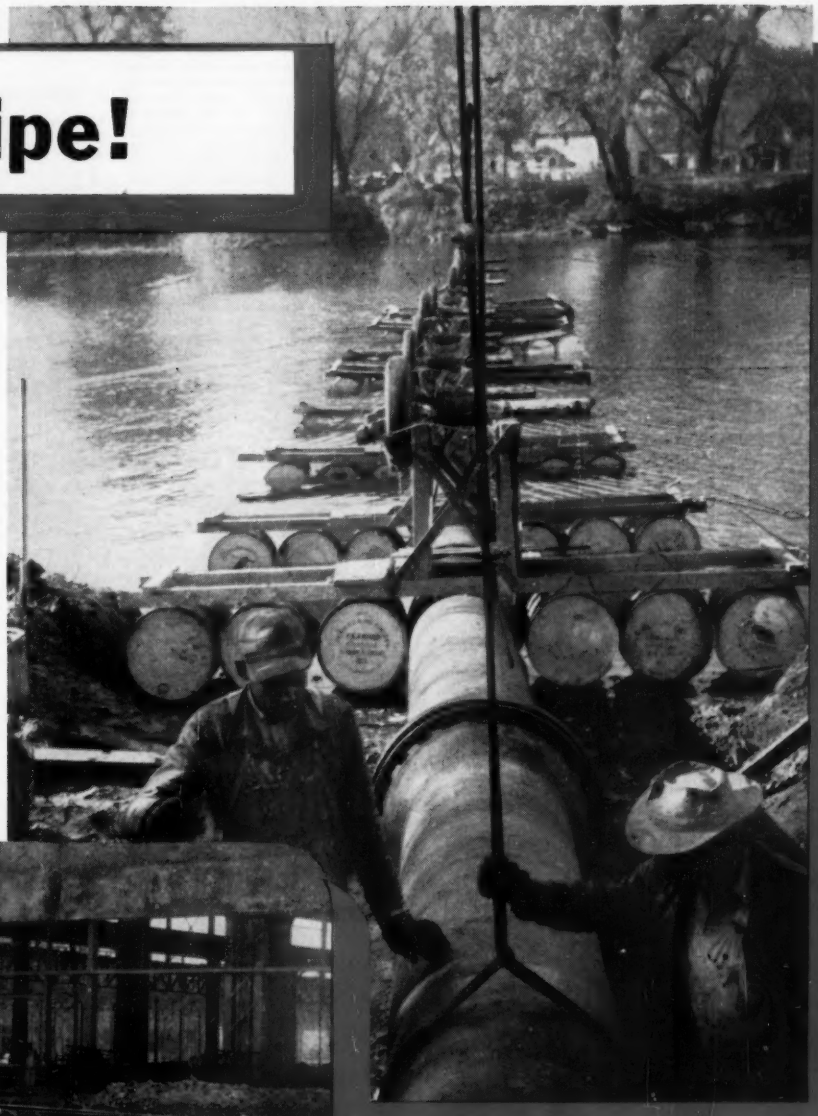
The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.



About a half-mile of 49-year-old 24" cast iron pipe dug up, cleaned and re-laid by Cincinnati, Ohio, Water Department.

CAST IRON PIPE

this pipe!



Flexible joint cast iron pipe being installed across Cedar River at Cedar Rapids, Iowa.

Cast iron pipe for large automobile assembly plant in New Jersey.

SERVES FOR CENTURIES...

Recent Books

(*Continued from page 120*)

Étude et Calcul des Structures en Alliages Légers

The major part of this work deals with design calculations for light alloy structural members, covering buckling, shearing, bending, and torsion for various girder sections. There are also brief sections on plate and web construction, combined stresses, riveting, welding, forming methods, and surface treatment. The author is J. Reinhold et les Services Techniques de L'Aluminium Français. (Librarie Polytechniques Ch. Beranger, Paris, 1955, 248 pp., bound. F frs. 3875.)

Flood Estimation and Control

A presentation of the author's methods for determining maximum flood intensity and for plotting the complete flood hydrograph. The book also deals with various published formulas for flood prediction, with the factors affecting flood discharge, and with regulating reservoirs and flood storage basins as means of controlling floods. B. D. Richards is the author. (Chapman and Hall, Ltd., London. Third Edition, 1955, 187 pp. bound. 35s.)

Studies in Ancient Technology, Vols. 1 and 2

These studies, by R. J. Forbes, are the first two of a series of eleven small volumes. Volume one consists of three essays, one a revision of the author's "Bitumen and Petroleum in Antiquity," the others devoted to the origin of alchemy and to water supply. The second volume includes four essays dealing with the following subjects: irrigation and drainage; land transport and road building; power; and evidence of the first domestication of the camel. (W. S. Heinman, 400 East 72nd St., New York, 21. 194 pp., and 215 pp., bound. $5.50 each.)

Engineering Drawing and Geometry

R. P. Hoelscher and C. H. Springer are the authors of a text, designed specifically for engineering students, emphasizes thoroughness in the understanding of principles rather than the achievement of manual skill. All the theory in descriptive geometry necessary for solving problems in design and drafting has been concisely presented. Drawing has been approached from the point of view of engineering usage as a whole. (John Wiley and Sons, Inc., 440 Fourth Ave., New York 16. various paging. 1956. $8.00.)

The Frost Penetration Problem in Highway Engineering

The main part of this book deals with the application of the following methods and theories to the analytical treatment of frost penetration in soil materials for highways and airports: the steady-state flow of heat; the unsteady-state flow of heat, F. Neumann's theory; J. Stefan's theory; and the suction force theory. Brief introductory chapters discuss the structural parts of highways, factors causing damage, and the national importance of the frost problem. The concluding chapters cover remedial measures, factors to be studied in frost action research, and some of the better known frost criteria. The author is Alfreds R. Jumikis. (Rutgers University Press, New Brunswick, N. J., 1955. 162 pp., $5.00.)

The Theory of Hydrodynamic Stability

Limited mainly to study of the stability of the motion of a homogenous viscous fluid with respect to infinitesimal disturbances, this volume gives a reasonably detailed treatment of the Couette flow and the Poiseuille flow as central to the development of the general theory of hydrodynamic stability. Boundary layer over a flat plate and other nearly parallel flows are dealt with, and a chapter is devoted to examples of stability problems in astrophysics and geophysics. The author is C. C. Lin. (Cambridge University Press, 32 East 57th St., New York 22, N. Y., 1955. 155 pp., $4.25.)

Vorlesungen Über Baustatik

This two-volume text on statics for structural engineering students covers the following material: Vol. 1: Analysis of statically determinate systems; stresses and elastic deformation; introduction to stability problems; and the statics of cables. Vol. 2: Analysis of statically indeterminate systems; the major types of structures and structural elements falling within this category are dealt with in separate sections. The author is Fritz Stüssi. (Verlag Birkhäuser, Basel, second edition (Vol. I), 1953, 1954. 370 pp., 313 pp., Sw. fr. 37.45, Sw; fr. 40.05.)

The Modern Building Encyclopaedia

An alphabetical listing of terms used in the building and allied trades in Great Britain. The entries range from brief definitions to articles of several pages, and in some cases describe the detailed work of such operations as arch construction and plastering. Tools are described according to the crafts or operations they concern, for example, concreting tools, excavating tools, and so on. Over 800 line-drawings are used to illustrate the text. Edited by N. W. Kay. (Philosophical Library, Inc., 15 East 40th Street, New York 16, 1955. 768 pp., $15.00.)

Piping Stress Calculations Simplified

This book, by S. W. Spielvagel, provides practical aids to designers of piping layouts by presenting exact solutions in arithmetical form to a number of typical problems in the calculation of pipe stress under changing temperature conditions. The present (fifth) edition incorporates the provisions of the 1955 American Standards Association "Code for Pressure Piping." (S. W. Spielvogel, 15 Old Field Lane, Lake Success, N. Y., 1955. 183 pp., $5.)

For Underwater Survey, Dredging and Oil Exploration . . .

NEW IMPROVED MODELS PRECISION DEPTH RECORDERS

ES 1025 3 Scales • ES 1025B 5 Scales • ES 1025F 8 Scales

3-Scale model ranges 2 to 60/120/180 feet. 5-Scale model provides additional ranges 180′ to 240′, 240′ to 300′. 8-Scale model includes 2 to 60/120/180/240 feet and 1 to 60/120/180/240 fathoms. All with automatic 5 foot overlap on each range. Built-in power supply. Built-in controls to correct for temperature, salinity, tide, draft and squat. Remote fix button included. Accuracy ±3 inches.

* *Tested and approved by civil and military engineers.*

Other Precision-Built Products:

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A FAMOUS NAME IN ELECTRONIC EQUIPMENT SINCE 1926

FOR PROPERTY LINES, RIGHTS-OF-WAY, PIPE LINES—

IDENTIFY REFERENCE POINTS Permanently-

Simply DRIVE

Copperweld TRADE MARK

SURVEY MARKERS

Copperweld* Survey Markers provide permanent, easy-to-locate points of reference that eliminate troublesome disputes. Economical and easy to drive, they can't rot or rust—won't splinter, bend or break. Bronze head can be center-punched and stamped for identification. If larger head is needed, a 4" adapter is available.

*Trade Mark

Standard length is 3 feet—other sizes made to order. Packed 10 markers to a carton.

Can't Rust! ← thick copper covering molten welded to steel core

Write for Bulletin 144

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION Glassport, Pa.

OHIO COUNTY FOUND ANSWER TO TODAY'S SLOPE CONTROL PROBLEM IN 1938

In 1938, one of the first installations of newly introduced Armco Bin-Type Retaining Walls was made to control a slope above this important county road.

16 years later another Armco Wall was installed to control the slope below the same road. Original wall is at the right.

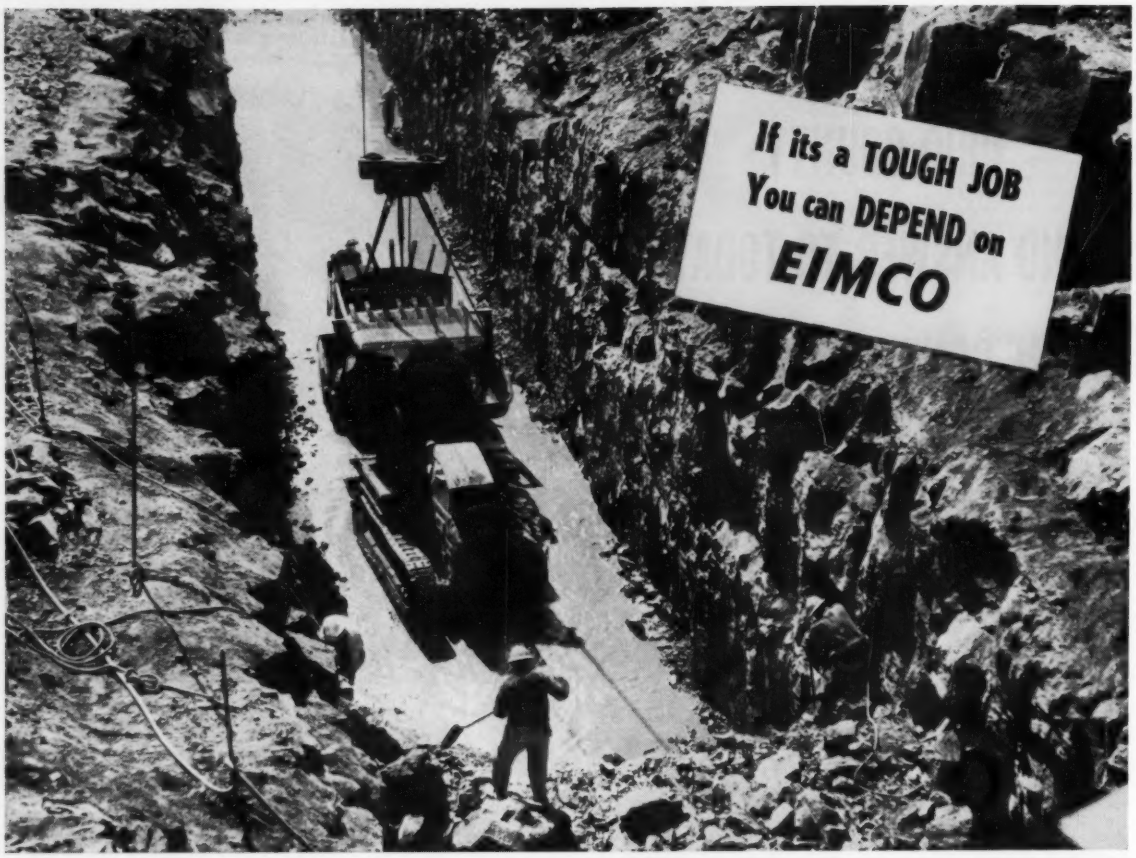
In 1938 Clermont County, Ohio, tackled an unstable slope problem along one of its roads with a new type of earth control product—Armco Bin-Type Retaining Walls. Other types of slope control had been tried but they lacked the stability and durability required. Today the Armco Wall is still on the job, in excellent condition.

Then, in 1954 another slope control problem developed below the same road. By this time the economy, stability and durability of the all-metal, bolted construction had been proved in service. Another Armco Wall was the logical answer.

Get the complete Armco Retaining Wall story now and see how easily and permanently you can solve *your* earth control problems. Write us for helpful data. Armco Drainage & Metal Products, Inc., 4516 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO BIN-TYPE RETAINING WALLS

ARMCO®

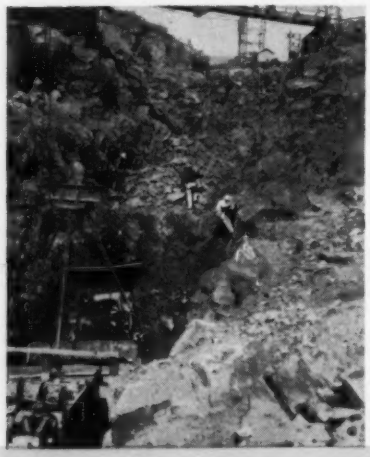


EIMCO KEEPS TOUGH EXCAVATION JOB ON SCHEDULE

Contractor — Montag - Halvorson - Cascade-Austin.

Location — The Dalles, Oregon.

Project — The Dalles Dam — Excavation of South Fishway.



Rock — lava basalt 91,000 cubic yards.

Report — Eimco's 105 Tractor Excavator was purchased for this job after several other types of equipment had been tried and proved either entirely unsatisfactory or incapable of maintaining the desired pace. The fishway (shown above) was excavated in lava basalt (typical of this section) with its characteristic flows and faults. Blasting in the faulted zone left many large blocky pieces of rock.

The method successfully used to excavate the shot rock from the 1500 foot long by 15 foot wide fishway channel which was 16′ deep at one end and 60′ deep at the other is as follows: A 6 yard rock ship was lowered by a crane and held in place by a Koehring Dumptor. It was loaded by the Eimco and hoisted out. "This method proved to be the most satisfactory and economical. Both machines took a terrific beating to get this job done, but to this day no one has been able to suggest a better way of doing it."

When it comes to bidding on a tough job — here are a few factors to consider: (1) Cubic yards of tough rock loaded per hour given proper haulage equipment — the Eimco will handle on a comparable basis with boom type shovels 1½ to 2 times its bucket size. (2) Cost—compare the prices. (3) Maintenance — compare these costs on jobs similar to your own. (4) Versatility — The Eimco moves quickly, easily. (5) Labor — compare the productivity per man hour.

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B-178

Applications for Admission to ASCE, Feb. 11–Feb. 25, 1956

Applying for Member

WILLIAM LEWIS ACKER, JR., Scranton, Pa.
ROBERT USHER ANDREWS, Fort Worth, Tex.
JAMES JOSEPH BYRNE, Washington, D. C.
NORMAN JOHN CASTELLAN, Sacramento, Calif.
GEORGE RAE EGAN, San Mateo, Calif.
LEROY ENGSTROM, Knoxville, Tenn.
MICHAEL JOSEPH HUBER, Plymouth, Mich.
ROLAND PAUL KELLY, Arcadia, Calif.
NORBERT ERNEST LANDDECK, Omaha, Nebr.
OIVIND MOE, San Francisco, Calif.
BENAIAH WEBB MOLLE, Walla Walla, Wash.
JOHN JAMES NOVOTNY, Baltimore, Md.
CHARLES LIEURANCE PRATT, St. Louis, Mo.
SABRI SAMI, Columbia, Mo.
HAIG SETIAN, New York, N. Y.
FRANK JOSEPH TRANI, Philadelphia, Pa.
EVERETT WAYNE WATKINS, San Diego, Calif.
RODERICK EUGENE WHITE, New York, N. Y.
JAMES CLARKE WILLIAMS, III, Washington, D. C.
JAMES HENRY WILLIAMS, Dallas, Tex.
BYREL NEVIL WILSON, Daytona Beach, Fla.
FRANK LEONARD WOODWARD, Minneapolis, Minn.

Applying for Associate Member

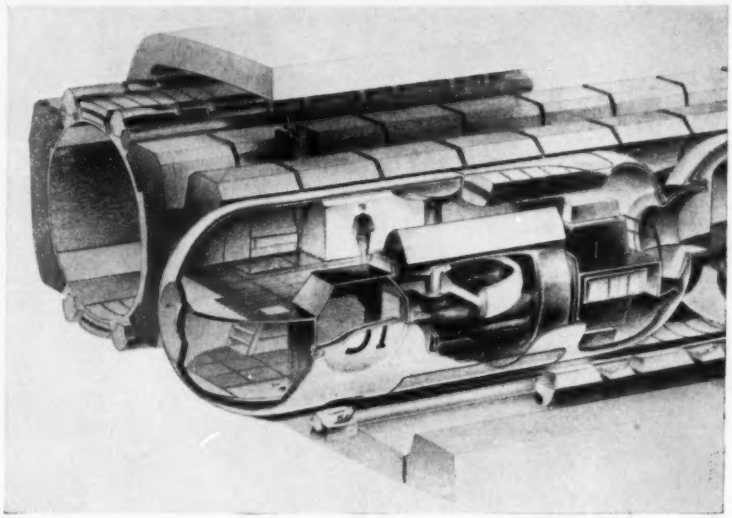
HAROLD MARTIN APPLETON, Jackson, Miss.
GURDIAL SINGH BHAGAT, Punjab, India.
WILLIAM HAROLD BUSSEY, Chicago, Ill.
GEORGE FRANCIS COEN, Flagstaff, Ariz.
DONALD JAMES COOLIDGE, JR., Juneau, Alaska.
PHILIP E. DOANE, Cuyahoga Falls, Ohio
THOMAS RODNEY GLENN, JR., New Brunswick, N. J.
KENNETH JOHN GRAY, Tasmania, Australia.
CHESTER ARTHUR GREEN, Borger, Tex.
DONALD ROBERT FERGUSSON HARLEMAN, Cambridge, Mass.
EUGENE FRANCIS HAWLEY, Detroit, Mich.
ARTHUR OSBORNE HENDERSON, Pittsburgh, Pa.
RALPH OWEN HILL, Pittsburgh, Pa.
RICHARD RALSTON KELLEY, Portland, Ore.
ARMOT KUMAR KHANNA, Bombay, India.
BERNARD JAMES LARVIN, Shreveport, La.
CARL ROBERT MAAR, Syracuse, N. Y.
EUGENE LYLE MCALLISTER, La Mesa, Calif.
EUGENE ROBERT MCMASTER, San Francisco, Calif.
HUGH WILSON MILLER, Hartford, Conn.
OLIVER HARVEY MILLIKAN, Bay Village, Ohio.
ARTHUR JEFFERY MULLKOFF, Detroit, Mich.
DODBALLAPUR SUBBARAYAPPA NARASIMA MURTHY, Bethlehem, Pa.
PHILIP BERNARD MUTZ, Denver, Colo.
LEON NADOLSKI, Oakland, Calif.
CECIL T. OVERBY, Lubboch, Tex.
FRANK BERT PATTERSON, Kansas City, Mo.
JUNIUS MYRL PENNY, Emporia, Kans.
GERARD MICHAEL POLIQUIN, Cloquet, Minn.
ROBERT WRIGHT PURDIE, Berkeley, Calif.
REINALDO RANALDI, Guayaquil, Ecuador.
WILLIAM SCHMITT, Ambridge, Pa.
BILLY JOE SHELL, Tucson, Ariz.
MAN BODH SINGH, P. W. D., India.
ALBIN ANTHONY STRAZDIS, Richmond Hill, N. Y.
MANFRED STRYK, Detroit, Mich.
DAVID SCOBELL SUMMERVILLE, Watertown, N. Y.
MONTGOMERY VANCE TRUSS, Birmingham, Ala.

Applying for Junior Member

EUGENE DANIELS BEAM, Pleasure Ridge Park, Ky.
JOHN NEWTON CAMPBELL, Columbia, S. C.
ISIDRO DIMARANAN CARINO, Quezon City, Philippines.
MARION WILLSON COREY, New York, N. Y.
RICHARD JENNINGS DRAKE, Kansas City, Mo.
JOHN GENE ENGMAN, Marysville, Calif.
HARRY WILLIS FILBY, Kansas City, Mo.
HAROLD GRAY GOLDEN, Jackson, Miss.
DALE EMERY GOSS, Los Angeles, Calif.
JOHN WILLIAM HARLLEE, JR., Miami, Fla.
WALTER CORNELIUS LAND, Decatur, Ga.
FRANK ALLEN MINK, JR., Pottstown, Pa.
GEORGE MORLEY PARK, JR., Peoria Heights, Ill.
JOSEPH MICHAEL PROVENZANO, New York, N. Y.
HERMAN DANIEL REGAN, JR., Vicksburg, Miss.
LAWRENCE GERALD SIRKIS, Sharon, Mass.
JOHN EDWARD SMITH, Rolla, Mo.
LOUIS HENRY STANLEY, Binghamton, N. Y.
FERNANDO JUAREZ PITANGA TAVORA, Rio de Janeiro, D.F., Brazil
ROBERT FRANKLIN TAYLOR, Philadelphia, Pa.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

MARS outstanding design **SERIES**

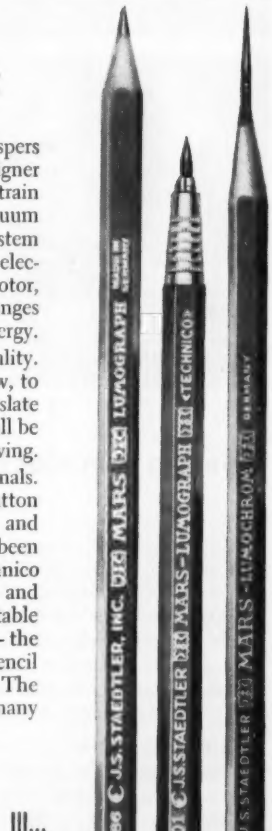


man and motion:

The wonders of the future are still little whispers in men's minds, or maybe — like Detroit Designer Norman James' magnetically suspended inter-city train — a drawing on a piece of paper. Traveling in a vacuum in an air-tight tube, it floats in space, held by a system of magnets built into cars and tunnel. Propelled electrically by "rolled-out" motor, train acts as rotor, tunnel roof as stator. Converter aboard train changes light projected through windows into electrical energy.

No one knows which ideas will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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This Boeing B-52 wing jig is 90 feet long and weighs more than 1,000 tons. Yet many of its tolerances are within 1/1000 of an inch—as close as a fine watch! Almost-absolute accuracy on a scale like this means that civil engineers at Boeing face one of the most stimulating challenges in production today.

Civil engineers, shown in the small picture, designed the optical alignment system for this jig in such a way that daily realignments can be handled by regular production personnel. Civil engineers have great responsibilities in Boeing production: in tool design, industrial engineering, liaison, and in other fields.

These civil engineers devise new fabrication methods for materials like titanium, hard aluminum alloys, and bonded honeycombs. They have supervisory responsibility in developing, checking and controlling production processes. Because of steady expansion, Boeing needs additional topnotch civil engineers for the B-52 and the 707 jet tanker-transport—and for big programs now under way on the airplanes and guided missiles of a few years hence.

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CIVIL ENGINEER (Sanitary); J.M. ASCE; B.C.E., 1954; M.S.S.E., 1956; 33, married. Prefer housing or city planning, but will consider other phases of sanitary engineering. Available June 1956. Location preferred, South or abroad. C-121.

IRRIGATION AND HYDRAULIC ENGINEER; J.M. ASCE; specialist in planning multiple-purpose river valley projects; over 30 years' experience in responsible capacity; available for foreign assignment in engineering or teaching, commencing fall 1956. Citizen of India, M.S. degree; salary open. C-122.

CIVIL ENGINEER; A.M. ASCE; B.S. in civil engineering, 1949; 38; married; 5 years' experience with railroad in bridge construction, main line changes, and division office; two years' experience as engineer in charge of large development program in South Louisiana. C-123.

PROFESSORSHIP IN STRUCTURAL THEORY AND/OR MECHANICS OF MATERIALS, desired by presently employed chairman of civil engineering department; A.M. ASCE. Much prefer teaching to administrative duties. Civil engineering degree; P.E. license; 30 years' teaching; some experience in building designs in spare time. Desired location, east of Mississippi River. C-124.

CIVIL ENGINEER; M. ASCE; 54; civil graduate; 30 years' private and public practice; registered New York, North Carolina, Virginia, Maryland, Nebraska, Washington, D.C., and Ohio; M.B.E.R. certificate of qualification. Administrative and supervisory experience in diversified fields: Turnpikes, airfields, water, sewage and waste treatment, dams, investigations, reports, planning specifications, estimates, contracts, supervision, construction materials. C-125.

SANITARY ENGINEER; A.M. ASCE; Dipl. Eng.; 39; married; 9 years' experience in design and preparation of plans and specification for sewage and water treatment plants, together with the design of the relevant reinforced concrete structures and supervision of resident engineer, in Germany, France, and South Africa. Will be available June 1. Location preferred, Southern California. C-126.

Positions Available

SALES ENGINEER, 27–35, civil graduate, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800–$6,000 a year. Location, Northeast. W-2165.

RESEARCH ASSISTANTS, full or part time employment, on projects in mechanics with emphasis on elasticity, vibrations and electrical instrumentation. Experience in applied mathematics or electro-mechanics desired. Opportunity for graduate study commensurate with research duties available in engineering mechanics, civil engineering, mechanical engineering, and applied mathematics. Salary, to $6,000 for full time of ten months' employment. Location, Florida, W-2848.

OFFICE AND FIELD ENGINEER, graduate civil young, to coordinate field work with the design on water and sewer construction. Salary, $6,000–$6,500 a year. Location, Washington, D.C. W-2854.

STRUCTURAL ENGINEER, to design steel, concrete, and timber structures, perferably with professional engineer's license in some eastern state. Salary depending on qualifications. Location, Eastern seaboard, Middle Atlantic States. W-2863.

CONSTRUCTION SUPERINTENDENT to select sites for new buildings, prepare details, plans, and specifications for renovation and rehabilitation of existing buildings; maintain liaison with architect regarding progress of construction or renovations. Salary, $5,720 a year. Location, New York, N.Y. W-2873.

SANITARY ENGINEER with B.S. degree and 2 to 4 years' minimum experience in sanitary design and construction fields. Salary, $5,190–$6,000 a year. Location, Westchester County, New York. W-2877.

INSTRUCTORS for Civil Engineering Department, rank and salary depending on experience. Location, Midwest. W-2920.

CONSTRUCTION SUPERVISORS, (*a*) Mechanical with at least 10 years' heating, plumbing and power plant installation experience, (*b*) Electrical with 10 years' installation experience covering lighting, communications, and power facilities. Single status only. Salary, $9,100–$10,400 a year. Locations, Labrador. F-2929.

CIVIL ENGINEER, Senior and Junior, graduates, for established public utility supervisory consulting organization. Senior, with minimum of 7 years' experience; Junior, with minimum of 3 years' experience. Work in connection with design of hydro systems, also structures and foundations for steam, hydro, and diesel plants. Some travel. Headquarters, New York, N.Y. W-2930.

SOILS ENGINEER, graduate, with experience in the testing and control of placement of soils, concrete and asphalt mixtures for work immediately, abroad and in New England. Salary, $5,000–$10,000 a year. W-2950.

TEACHING PERSONNEL for department of civil engineering, rank depending upon qualifications. Prefer M.S. degree. Will teach courses in mechanics and civil engineering with exception of structural theory and design. Salaries open. Location, New York State. W-2960.

INSTRUCTOR, M.S. or Ph.D., to teach surveying, highways, fluid mechanics, testing materials and normal civil engineering lab. Should be active in technical and professional organizations. Salary and rank will depend upon degree and experience. Position starts September 1956. Location, Ohio. W-2978.

FIELD ENGINEER, recent graduate, civil engineer or architect, with major in structural design under 30. Experience in design and construction in structural steel with a consulting engineer, structural steel fabricator, or a contractor in sales promotion or personal contact work, is desired. Some traveling. Salary open. Headquarters, Southwest. W-2989.

ADMINISTRATION ENGINEER, civil graduate, with strong background in building construction, to purchase materials, coordinate construction contracts, and supervise installation. Should be licensed, preferably in New Jersey. Salary, $10,000–$12,000 a year. Location, New Jersey. W-3019.

RESEARCH ASSOCIATE IN HYDRAULIC ENGINEERING, 25–35, preferably with M.S., for diffraction and retraction studies of sea waves, meas-

(*Continued on page 130*)

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(*continued from page 129*)

urement of wind effects, erosion and similar duties. Salary, $4,200–$5,400 a year. Location, Massachusetts. W-3024.

DESIGN ENGINEER to perform and supervise performance of contract drawings and specifications for sewage treatment plants, pumping stations, water systems. Must have some experience in the fields mentioned. Salary open. Location, upstate New York. W-3025.

SANITARY ENGINEER, graduate in civil, sanitary, public health, chemical, general or architectural engineering, and 4 years' experience in sanitary engineering; or an M.S. degree in sanitary engineering or public health and 3 years' experience. Will perform administrative and professional engineering work in development and application of sanitary measures for prevention and control of diseases caused by environmental factors, such as municipal water, sewage disposal, etc. Salary, $5,604–$6,780 a year. Location, South. W-3030.

CIVIL ENGINEER, 21–40, to build roads, factories, hydroelectric plants and other facilities. Long-time overseas assignment. Single or married status, no children. Salary, $6,000 a year, plus 40 percent foreign service. Location, Liberia. F-3037.

CIVIL ENGINEERS, Junior and Senior Assistants, with experience in railway construction, maintenance, and survey work. Knowledge of Spanish desirable but not essential. Home leave with passages paid every 2½ years. Salary open. Location, South America. F-3052.

ENGINEERS. (*a*) Superintendents, experience in general building construction and some specific experience in reinforced concrete work. Salary, $9,100–$11,700 a year. Location, east of the Mississippi. (*b*) Estimator, in building work, some experience in reinforced concrete work. Salary, $7,020–$7,800 a year. Location, Massachusetts. W-3057.

CONSTRUCTION ENGINEER, young, civil graduate, to check materials and quantities, prepare estimates and job changes, excavating and heavy construction work. Salary, $5,200–$6,500 a year. Location, Northern New York. W-3071.

CIVIL ENGINEER, young, B.S. or M.S. preferred, with 1 to 2 years' experience in civil engineering, to work as general engineering assistant; work will involve design, drafting, specifications, field work, inspection, and related duties as assigned. Occasional traveling. Salary, $6,000–$6,500 a year, expenses paid when traveling. Headquarters, New York, N.Y. W-3089.

RESIDENT ENGINEER ON ROCKFILL DAM, graduate civil or equivalent, 40–60, with experience on at least two rockfill dams, rockfill dam construction foundations and geology. Will do interpretation of plans and specific supervision of field engineering staff and inspect staff; act as liaison between contractor, client, and consultant engineers. Complete administration of the field office. Duration 4 years. Salary, $18,000–$21,840 a year depending on experience. Location, Iraq. C-4654.

DEPUTY RESIDENT ENGINEER, graduate civil or equivalent, 35–60, with 10 years' experience in dam construction and at least 1 year's experience on a rockfill project. Must know rockfill dam construction foundations and geology. Will supervise field engineering and inspect staff, expedite contractors operations (contacting supervisors of all phases of project), and observe methods and progress, anticipation of potential complications. Duration 4 years. Salary, $15,000–$16,800 a year. Location, Iraq. C-4655.

SALES ENGINEER, SANITARY EQUIPMENT, to 45, with 2 or more years' experience in sewage-treatment plants, to sell sanitary equipment to municipalities and others. Mostly local traveling. Car required. Salary, $6,000 a year, plus commission. Employer will pay placement fee. Locations, New York and San Francisco. C-4659.

CITY ENGINEER OR ASSISTANT, graduate civil, 35 or more, with 5 or more years' experience in field and office on municipal projects, and must know building codes. Will be in complete charge of field and office work on municipal projects for city of 9,000 population having extensive territory. Should be registered engineer or able to obtain license. Salary, $7,200 a year, plus. Employer will pay placement fee. Location, Chicago suburb. C-4694.

CIVIL, ARCHITECTURAL, STRUCTURAL, AND SANITARY ENGINEERS, to work on municipal, sanitary, and military projects with long-established consulting firm. Salary open, plus profit-sharing and retirement plant. Location, Southern California. S-1487.

JUNIOR CIVIL ENGINEER, B.S. in civil engineering, young, with 1 year's experience or more in streets, highways, or subdivisions, to assist city engineer in office and field. Salary, $5,620 a year. Location, San Diego County, California. S-1486.

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New Publications

High-strength steels . . . To fill a need growing out of the development and widening application of high-strength low-alloy steels, the U.S. Steel Corp. has made available a working handbook for architects and engineers entitled "Design Manual for High Strength Steels." The 174-page booklet contains numerous charts and formulas for structural carbon steel as well as high-strength steels, and can be used as a multi-purpose design manual. Copies are available from the U.S. Steel Corp., 525 William Penn Place, Pittsburgh, Pa.

Surveying . . . "Slope Staking Made Easy" is the title of a small booklet prepared and published by Emanuel Johnson, as an aid to construction engineers. Copies sell for $1 each, and may be obtained from Mr. Johnson at 639 "E" St., San Diego, Calif.

Soil mechanics . . . Through the U.S. National Council on Soil Mechanics and Foundation Engineering, the Royal Swedish Geotechnical Institute announces that it is setting up an international geotechnical literature service. Each paper in the field of soil mechanics and foundation engineering, wherever published, will be classified according to its content and one or more filing cards prepared for it. It is expected that about 2,000 cards will be issued a year (in English only at first). The service will cover all new publications, as they appear, and later references will be compiled for the period prior to January 1, 1955. Engineers interested in subscribing at a cost of $50 a calender year should advise the Institute—Statens Geotekniska Institut, Narvavagen 25, Sweden.

Georgia surface water resources . . . Factual information on the effect of the Georgia drought of 1954 on the surface-water resources of the state is given in Information Circular No. 17 (Part I) issued by the State Division of Conservation, Department of Mines, Mining, and Geology. The report—prepared cooperatively with the U.S. Geological Survey—is published in two parts in order to make the observed stream-flow data in Part I immediately available for use in the design of reservoirs and other measures for protection against recurring droughts. Part II, the analytical portion of the report, will be published when the analyses are completed. Inquiries should be sent to the State Division of Conservation, 425 State Capitol, Atlanta, Ga.

Blast-resistant construction . . . The American Concrete Institute has reprinted the paper "Design of Blast-Resistant Construction for Atomic Explosions," by C. S. Whitney, M. ASCE, B. G. Anderson, A.M. ASCE, and E. Cohn. This 96-page paper, which appeared in the ACI Journal for March 1955, is available, in covers, for $1.50. Send orders to the ACI, 18263 West McNichols Road, Detroit 19, Mich.

Flood control. . .Availability of two new manuals (Nos. 6 and 7) in its Flood Control Series is announced by the Bureau of Flood Control and Water Resources Development of the United Nations Economic Commission for Asia and the Far East. No. 6—entitled "Standards for Methods and Records of Hydrologic Measurements"—covers (Part I) methods of measurement of precipitation and evaporation, water level, discharge, sediment load, ground water, etc., in the Far East, and gives (Part II) the standard forms for a hydrologic yearbook that will be useful in planning and designing projects. No. 7—"Multiple-Purpose River Basin Devleopment: Part I, Manual of River Basin Planning"—describes and discusses basic problems arising in the preparation of a comprehensive river basin plan. Each series sells for 80 cents (or the equivalent in other currencies). It is available from the Economic Comission for Asia and the Far East, Santitham Hall, Rajadamnern Ave., Bangkok, Thailand, from the United Nations Bookshop in New York, and from UNESCO sales agents everywhere.

Engineer recruitment . . . For the mutual benefit of the railroads and young civil engineers and engineering students, the AREA's Committee on Cooperative Relations with Universities has prepared an engineer recruitment brochure called "The Railroad Field—A Challenge and Opportunity." Free copies of the 28-page brochure may be obtained from the American Railway Engineering Association, Construction and Maintenance Section, 59 East Van Buren St., Chicago 5, Ill.

Aluminum handbook . . . A revised manual for designing in aluminum has just been released by the Aluminum Company of America. Called the "ALCOA Structural Handbook," the 368-page volume contains a wealth of tabular data and designing devices; a complete description of the characteristics of the metal, with methods of manufacture and fabrication; and design rules including specialty designs for connection, storage vessels, and pressure vessels. New material includes a greatly extended list of products and principal mechanical property tables with minimum rather than typical properties. Inquiries should be sent to the Aluminum Company of America, Alcoa Bldg., Pittsburgh, Pa.

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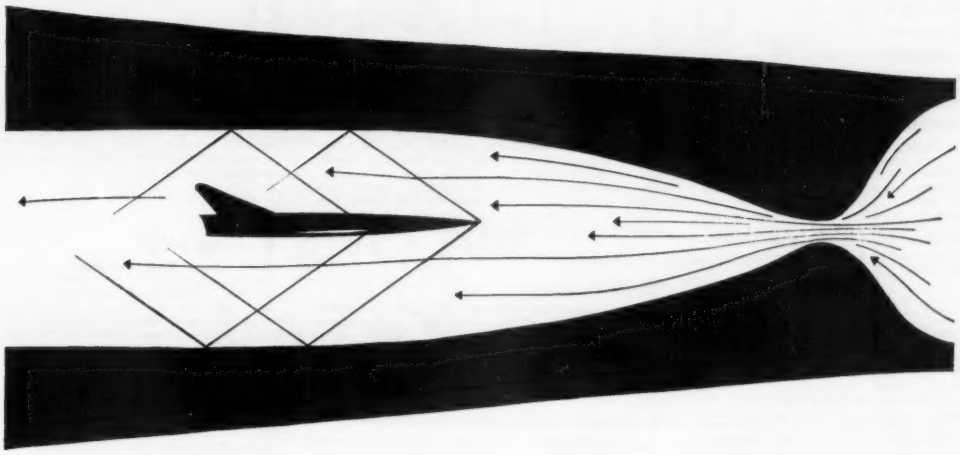

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Contact: Mr. D. S. Grant
Engineering Personnel Office Dept. 91-20 CIV
12214 Lakewood Blvd., Downey, California

NORTH AMERICAN AVIATION, INC.

CATALOG DIGESTS of ENGINEERING and INDUSTRIAL interest

1 AERIAL MAPPING

Aero Service Corporation—Literature covering new and more economical applications of varied aerial mapping services is offered. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning.

2 AERIAL SURVEYS

Alster & Associates, Inc.—Latest information on aerial surveys is offered in a booklet "Topographic Mapping From Aerial Photography." Fully illustrated, this booklet describes how maps are made from aerial photographs and analyzes uses and advantages of the topographic, planimetric and mosaic maps the firm produces. Explains how the photogrammetric method reduces survey costs as much as 75% compared to conventional ground survey methods.

3 AERIAL SURVEYS

Jack Ammann Photogrammetric Engineers, Inc.—A new article entitled "Topographic Mapping pays off for Dallas" explains the problems accompanying the expansion of any metropolitan area, and in particular, Dallas, Texas. The brochure shows how this was accomplished by detailed planning and the uses of aerial photogrammetric maps developed by the company.

4 AIR-COOLED CONDENSER

Halstead & Mitchell—A remote air-cooled condenser is described in detail in a four-page booklet. A self-contained unit with no water needed, the condenser features an efficient core design which allows high air volumes at low speed. A table of performance data for the various size units is given as well as dimensions and weights.

5 AIR DEVICES

Lunkenheimer Co.—A new three-color illustrated folder, Circular 587, describes uses, performance and sizes of various air devices: cocks, nozzles, check valves, globe and angle valves, plus table of estimated cost of air leaks.

6 AMSEAL JOINTS FOR CONCRETE PIPE

American-Marietta Company—Illustrated folder covers the various uses for Amseal—"A Pressure Proven Joint" furnished on low pressure concrete pipe. Blueprint and drawings show construction features. Specifications and basic dimensions are given for pipes and joints. Photos show fabrication methods and installations of concrete pipe with Amseal joints.

7 ASPHALT PLANT

Madsen Works—The catalog illustrates and describes the Madsen 2000-lb special asphalt plant. The plant is rated at 60-tons per hr, yet consistently produces in excess of 80-tons per hr. It is considered the ideal asphalt plant for handling jobs up to the 10,000-ton class economically and to rigid specifications. The catalog shows diagrammatic drawings and complete specifications and engineering data.

8 AUGER DRILLS

The Salem Tool Company—Earth and rock boring auger drills are described in Bulletin M-105. Features of horizontal blast hole drills are explained, as are the following features of truck-mounted and self-propelled drills: power unit, transmission, main drive case, carriage, main frame, hydraulic unit and elevating jacks.

9 AUTOMATIC COUPLERS

Mayo Tunnel & Mine Equipment—A simple and economical automatic coupler for small mine cars is described in a recent brochure. In addition, side-dump cars, rocker-dump cars, car passers, pneumatic grouters, and muck bins are explained and illustrated.

10 AUTOMATIC LEVELING

Filotecnica Salmoiraghi, Inc.—A comprehensive booklet describes a new automatic level model 5172, designed on the suspension-lens principle, by which leveling is attained automatically and maintained indefinitely even if the instrument is inclined. Its use, maintenance and applications in surveying and construction work are fully explained. Catalog and descriptive literature are also available on the F/S repeating theodolite, optical planimeter with built-in tracint point and repeating lever, and a full range of conventional leveling instruments.

11 BITUMULS FOR BASE CONSTRUCTION

American Bitumuls & Asphalt Company—Offers a 12-page, two-color booklet, "Bitumuls for Base Construction," which is an illustrated and valuable guide on the modern methods and equipment for construction of stable, water-resistant bases for pavements. Various types of aggregates may be used, after proper laboratory classification in this method of construction.

12 BITUMULS FOR SURFACE COURSE MIXES

American Bitumuls & Asphalt Company—Offers a 12-page, two-color booklet, "Bitumuls for Surface Course Mixes," which is a guide to the modern methods and equipment for construction of wearing surfaces for pavements. Amply illustrated, this booklet covers various methods, including valuable laboratory guides.

13 BOILERS

The James Leffel & Co.—Interesting comparison figures and important data for the prospective boiler buyer are available. Comparison figures are based on strength, weight, length of service and low maintenance cost of the company's Scotch boilers.

14 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations," Catalog B-5 explains the reason for subsoil investigations, what Gow borings are and how they are made, and the results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

Mail This COUPON To-day

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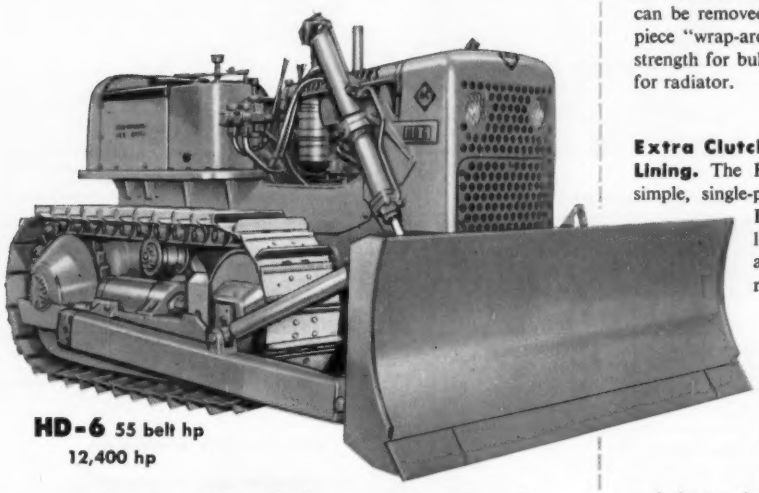
NOT GOOD AFTER May 15, 1956, for readers in the U.S., but requests will be accepted to June 30, 1956, from readers outside of this country.

Use This Free Service—Mail The Coupon To-day

This kind of Crawler Tractor Design gives you extra output



HD-6 55 belt hp
12,400 hp

. . . and only Allis-Chalmers HD-6 has it—

advanced design features that combine big performance, versatility, dependability and simplified servicing!

Look at the Allis-Chalmers HD-6—you can see its functional design . . . how it's built to give sure-footed traction, better working balance. But there's more to this crawler tractor than meets the eye—the performance advantages of Allis-Chalmers advanced basic design. It provides more working power, more strength in all components, more working weight where it's needed . . . makes the HD-6 an outstanding performer with drawn or mounted equipment . . . easier to operate and maintain.

Let your Allis-Chalmers dealer show you how the HD-6 can give you that *extra* output on your jobs.

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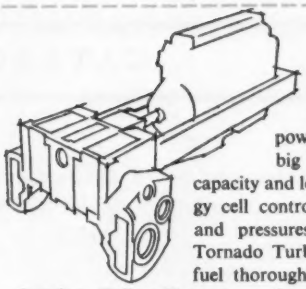
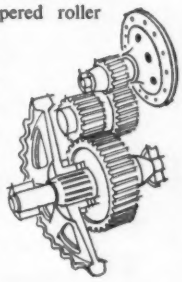


Allis-Chalmers Heavy-Duty Diesel Engine. The HD-6 power plant is designed for big output, ample reserve capacity and low maintenance. Energy cell controls combustion timing and pressures for high efficiency. Tornado Turbulence mixes air and fuel thoroughly for more complete burning. Follow-Through combustion sustains effective working pressures to take advantage of better crankshaft leverage.

Special Strength and Protection. Exclusive all-steel box-A main frame makes possible superior over-all balance, better equipment mounting . . . plus service simplicity of unit construction. Major assemblies like engine and clutch can be removed without disturbing adjacent parts. One-piece "wrap-around" radiator guard provides maximum strength for bulldozer mounting . . . complete protection for radiator.

Extra Clutch Life—with Ceramic Lining. The HD-6 master clutch offers simple, single-plate, over-center design. Revolutionary new ceramic button clutch lining keeps clutch operating longer between adjustments . . . lengthens clutch life . . . reduces lever pull for easier operation.



Straddle-Mounted Final Drive Gears. Tapered roller bearings support both ends of the final drive gear shafts. Smaller gears and shorter shafts (plus line-bored, one-piece case), provide better bearing and gear alignment, more strength, longer life. Double-reduction final drives provide greater ground clearance.

New-Design, Heavy-Duty Track. HD-6 track provides long life under the toughest conditions. HD-6 sidebars have more steel where it's needed . . . benefit from new heat-treating methods which make possible new standards of strength and hardness throughout for extra wearability.

Other Outstanding HD-6 Features

. . . no other tractor in this size class has them—at no extra cost you get roller bearing truck wheels, idlers and support rollers; 1,000-hour lubrication intervals for truck wheels, idlers and support rollers; 24-volt direct electric starting; crankcase guard; bumper; and lights.

ALLIS-CHALMERS

CATALOG DIGESTS

15 BUILDING CONSTRUCTION HANDBOOK

L. Sonneborn Sons, Inc.—Over 120-pages of a building construction and maintenance handbook cover the company's entire range of products, each fully described and illustrated. Easy reference is made accessible with three indexes of products, uses and charts. 15-pages are devoted to various tables, estimating guides and measurements.

16 BUILDING DAMS

Caterpillar Tractor Co.—An eight-page booklet, "Building Dams," discusses the machines needed for dam building. The illustrated booklet reviews the different dam building jobs and shows action shots of wheel-type tractors, track-type tractor and bulldozers, and industrial engines in a variety of jobs. This booklet is also available in French, Spanish and Portuguese.

17 CALCIUM CHLORIDE

Calcium Chloride Institute—"Calcium Chloride for Stabilization of Bases and Wearing Courses" was written to assist highway engineers, contractors, and materials suppliers when they use calcium chloride in the construction of dense graded bases and wearing courses. The manual deals with the properties and design, types and methods of construction, and specifications. It is well illustrated, and information is presented as a guide for both design and construction engineers.

18 CASE HISTORY

Connors Steel Division, H. K. Porter Company, Inc.—A case history of this company's role in supplying the reinforced steel for the construction of a sewage treatment plant is the subject of a brochure with photographs of actual job applications.

19 CAST IRON MAINS

Cast Iron Pipe Research Association—A third edition of an illustrated booklet deals with the service records of existing cast iron mains laid in the 17th, 18th and 19th centuries. A summary of service records of cast iron water mains in 25 cities, based on a study sponsored by three water works association, is also recorded.

Turn to page 134 and order your literature.

20 CAST IRON PIPE

U. S. Pipe & Foundry Co. An eight-page booklet on centrifugally cast roll-on joint pipe for water, sewage or other liquids contains a table of dimensions and weights and illustrations showing progressive steps in assembly of roll-on joint.

21 CAST IRON PIPE, HYDRANTS AND VALVES

R. D. Wood Company—A new general catalog has recently been issued providing full details of weights and dimensions of "sand spun" cast iron pipe and cast iron fittings. This catalog also features fire hydrants, gate valves and other products manufactured by this company.

22 CEMENT GUN

Cement Gun Company, Inc.—Of considerable interest to the engineering profession is a 65-page booklet, designated as Bulletin 3000, describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

23 COAL RECOVERY DRILLS

The Salem Tool Company—Bulletin M-101, a four-page, two-color pamphlet describes coal recovery drills 16-in. to 42-in. in diameter for 6-in. augers. Photographed are a heavy-duty barrel-type drill head, 42-in. in diameter with tungsten carbide 3-prong pilot adjustable core burster, reinforced double auger flighting, barrel equipped with bug dust clearance spirals; and a 36-in. heavy-duty nut and slack drill head for drilling rock and producing nut and slack coal.

Knoxville Convention of ASCE
Knoxville, Tennessee, June 4–8, 1956

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Perkins Hall, Univ. of Tennessee
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Sure, I'm planning to come to the Knoxville Convention.

Check one

☐ Glad to say, the wife is coming too.

☐ Sorry, but I have to come by myself this time

Name.....

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Section.....

CATALOG DIGESTS

24 COFFERDAMS

Spencer, White & Prentis, Inc.—"Cofferdams," by Lazarus White and Edmund Astley Prentis is a trusted source-book covering actual design and construction of cofferdams as well as the theoretical features. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

25 COILFILTER

Komline-Sanderson Engineering Corp.—Available bulletins on the Coilfilter, a modern vacuum filter, describe how this filter is designed for modern sludge dewatering requirements. Outstanding features of the filter are defined as nonclogging, permanent filter media, constant output and low operating cost.

26 COMMERCIAL CATALOGS

Commercial Shearing and Stamping Company—Has available several leaflets describing their oil hydraulic controls, standard steel shapes, stampings and forgings, and oil hydraulic pumps, motors, and cylinders. Clear photographs illustrate representative items of each of these products and interesting sketches show their end use. Contents include details and data.

27 CONCRETE ADMIXTURES

Sika Chemical Corporation—Brochures describe Plastiment retarding densifier and Sikacrete accelerating densifier. Test data and specifications are included. Information on prestressed concrete, lightweight concrete, floating concrete structures, extra-duty concrete floors is also available.

28 CONCRETE FORMING EQUIPMENT

Universal Form Clamp Co.—A four-page Bulletin illustrates and describes the Uni-Form panel system as applied to sewage treatment plant construction.

29 CONCRETE FORMING SYSTEM

Economy Forms Corporation—A catalog with pictures is offered showing a complete forming system available to contractors on a purchase basis. The easy adaptability of these forms to all types of form work, plus engineering layout service on each new project, together with a complete steel form good for a lifetime of service makes the new EFCO form an attractive investment for the large and small builder.

30 CONCRETE MANUAL

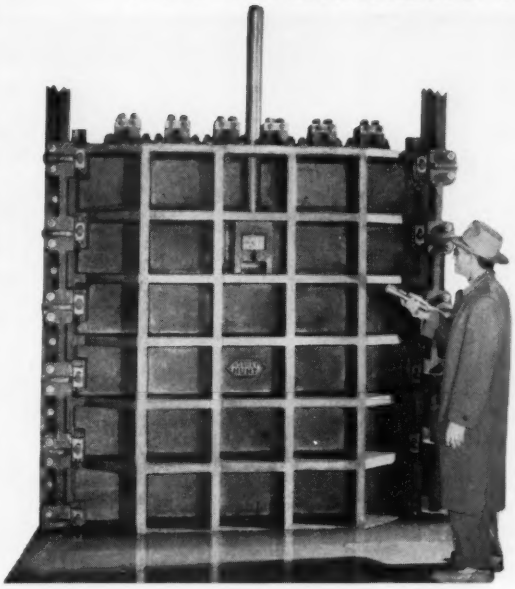
Calcium Chloride Institute—Concrete users will be interested in a 40-page manual entitled "Calcium Chloride in Concrete." A ready reference to quantitative data, it includes nearly 20 charts and 40 illustrations which refer to the various aspects of calcium chloride as it is used in modern concrete construction. There is data on initial and final set, cold weather protection, air-entrained concrete, and integral curing.

31 CONCRETE PAVEMENT MANUAL

Portland Cement Association—This new 72-page illustrated manual gives details of geometric pavement designs and outlines the best methods of construction. It presents in summarized, usable form, data on pavement layout and construction from recent technical society proceedings, engineering publications, field observations, tests and experience.

(Sent in U.S. and Canada only.)

FOR GENERATIONS TO COME!



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Controlled cast iron from our own modern foundry ... heavy bronze wedges ... generous bronze wedge seats ... seat facings of malleable extruded bronze, pneumatically impacted and work-hardened in machined dovetail grooves of disc and frame ... these are typical of the workmanship which gives Rodney Hunt Sluice Gates their unique value and true economy for generations to come!

Specify Rodney Hunt Sluice Gates for standard sizes of 6 x 6 to 120 x 120 inches clear opening, rectangular or round. Over 2000 combinations of standard Rodney Hunt Sluice Gates, including many of unusual dimensions, are available with precision-built hoists.

Write us for the name and address of the Rodney Hunt representative in your area. He'll be glad to give you quotation information and engineering assistance.

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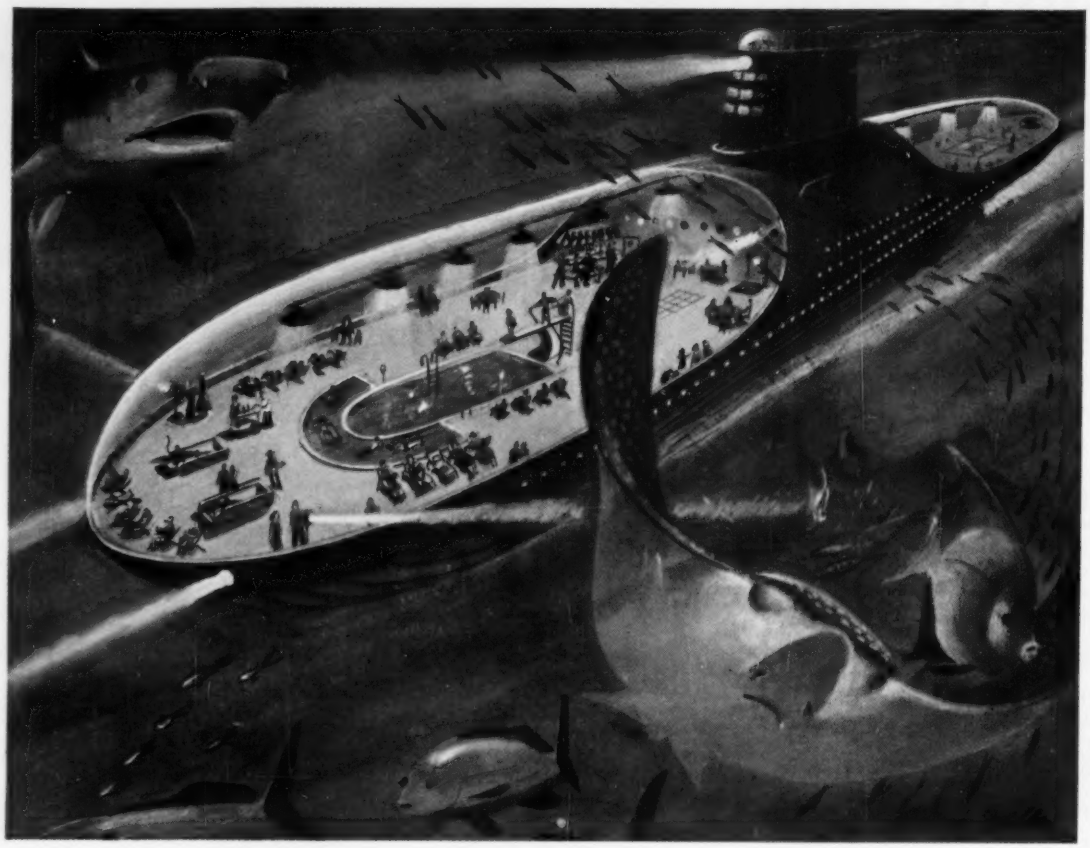


HUGE submarine liners with glass capable of withstanding tremendous pressure may offer the traveler of the future intimate glimpses of life under the sea and immunity from storms and seasickness.

100 years from now...

WE MAY SIGHTSEE UNDER THE SEA!

The world of the future—full of amazing, time-saving, health-giving products and machines. Still being used, however, will be the reliable cast iron water and gas mains laid today.

Records show that over 60 American cities from coast to coast are still served by cast iron water and gas mains laid more than a century ago. And modernized U. S. Pipe... centrifugally cast, quality-controlled from mines to finished product... is extra rugged, more dependable than ever.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

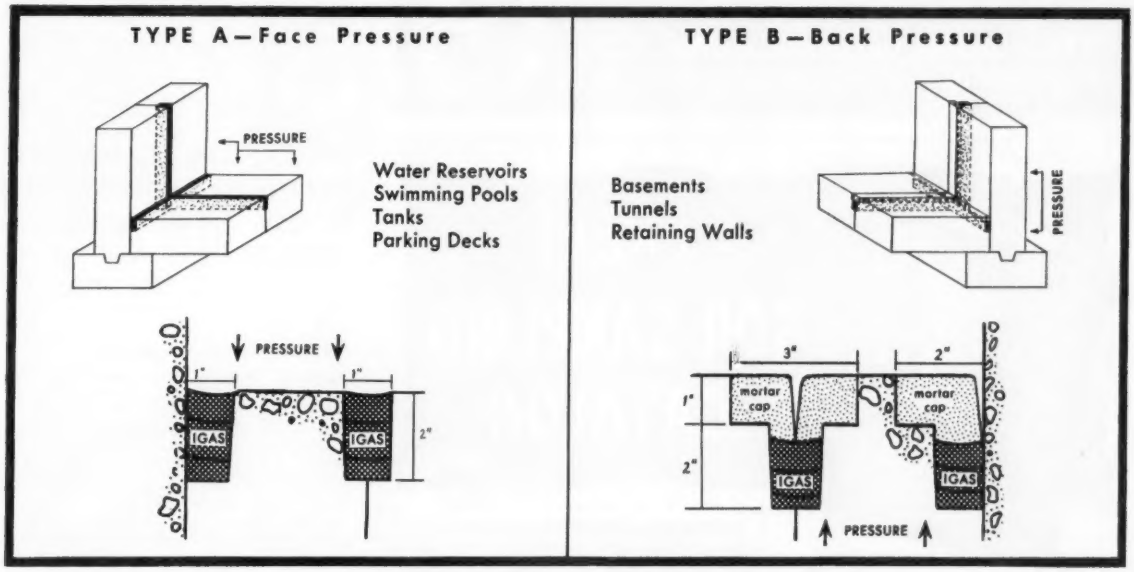
IGAS® JOINT SEALER

the non-meltable mastic waterstop

for joints in concrete, metal and other construction materials

Igas Joint Sealer is a tough, resilient, non-meltable mastic installed after concrete hardens — simply and easily. Igas does not dry out or become brittle with age. It is easily installed in vertical, horizontal and overhead joints, and forms a continuous watertight seal, even at the junctions of joints. Igas is effective at temperatures from −10° F. to 180° F. (special grades for other temperature ranges).

2 basic designs solve most joint problems



Joint sizes and types shown here are suitable for most jobs. Type A joints will sustain a 20 foot head of water with movement in the joint of 1/8". Type B joints will sustain a 20 foot head of water with movement in the joint of 1/16". Other joint details are available for special problems involving greater movement and greater water pressure.

Write or call today for full recommendations, specifications, and architectural details. There is no obligation, of course.

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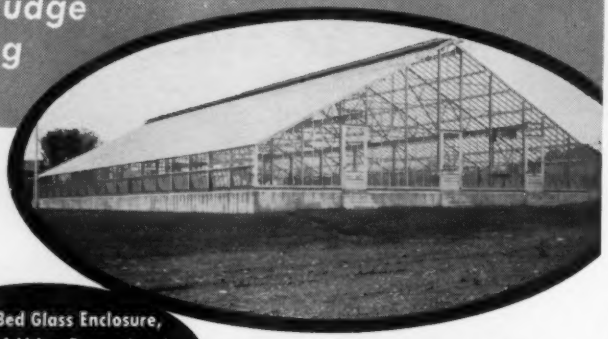

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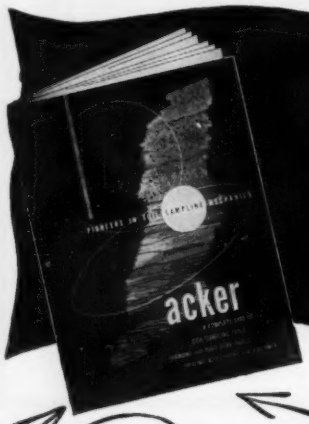

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This complete, instructive collection of information about soil sampling in all subsurface conditions, shallow or deep, with hand or power driven tools, is yours for the asking. Modern sampling techniques are discussed with recommendations as to tools and accessories best suited for fast, accurate, economical sampling.

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CATALOG DIGESTS

32 CONCRETE IN WATER WORKS

Portland Cement Association—A 15-page illustrated booklet describes the wide use of concrete structures in bringing raw water from its source to the user. Concrete dams, pipelines, canals, tunnels, filtration and service buildings, sedimentation and flocculation tanks, storage reservoirs and distribution mains are shown as a few examples of the extensive uses and general utility of prestressed and conventional concrete in the construction of water works projects.
(Sent in U.S. and Canada only)

33 CONCRETE PIPE BALLAST

American-Marietta Company—An illustrated folder shows how to stabilize underwater pipe lines with Amwate reinforced concrete pipe ballast. Photos of construction methods and many installations being made explain Amwate's special rounded construction.

34 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication is available to engineers. It contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

35 CONCRETE PIPE HANDBOOK

American Concrete Pipe Association—This handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. A thorough comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.T.M. and AASHO specifications. Price $4.00.

N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.

36 CONCRETE SAWS

Eveready Briksaw Company—Prices and specifications on all products are given in Folder No. 102. This includes masonry saws, concrete saws, blades and a dust control unit for use when cutting dry with the masonry saw. A booklet, "How to Cut Blade Costs in Masonry Cutting," is also available.

37 CONCRETE SHORE PROTECTION

Portland Cement Association—Engineers and officials concerned with beach erosion control will be interested in a new, illustrated 30-page booklet on the use of concrete shore-protection structures. The booklet presents a discussion of wave action as well as other factors influencing the type and design.
(Sent in U.S. and Canada only.)

CATALOG DIGESTS

38 CONCRETE TESTING EQUIPMENT

Soiltest, Inc.—New bulletin on specialized field and laboratory testing apparatus for concrete contains complete description of portable concrete testing machine having a capacity of 200,000 pounds. Also illustrated and described are various accessory items such as air meters, yield buckets, laboratory mixers, beam forms, cylinder molds, capping sets and flexure testers.

39 CONVEYORS

Link-Belt Company—Trukveyors, a dragline conveying medium designed to reduce the unit cost of materials handling in warehouses, truck and railroad terminals, are described in detail in a 24-page illustrated book. Book 2497 describes both the overhead and in-the-floor types of Trukveyor.

40 CORE DRILLS

Acker Drill Co., Inc.—Acker Bulletin 30 describes the Teredo core drill. The basic Teredo rig can be equipped with either a hydraulic or mechanical screw feed. Power plant can be either gasoline, diesel, air or electric motor. The unit is readily adaptable for mounting on drag skid, jeep, truck or trailer.

41 COST DATA

Barco Manufacturing Company—Of interest to earthmoving contractors is a bulletin of cost data for soil compaction in restricted areas. Specifications accompany the data.

42 CRAWLER TRACTOR

Allis-Chalmers Manufacturing Company—The technical and operating story of the 45 drawbar hp HD-6 diesel-powered crawler tractor is told in a new catalog. In addition to specifications, the catalog lists the full line of matched equipment and accessories that have been engineered to the HD-6 which increases its versatility and economy, and provides maximum safety and comfort for the operator.

43 DESIGN HANDBOOK

Barkside Valves—A 56-page design handbook and catalog provides the means for proper selection of a pressure switch for every application. It contains a step by step selection chart, a complete rundown, illustration and tabulation of all the detail features leading to the unit that solves the control problem.

44 DEPTH SOUNDER

Edo Corporation—A four-page brochure describes the Model 185 AN/UQN-1B, precision deep depth sounder, with a range from 0 to 6,000 fathoms, which was developed for the U. S. Navy and is now available commercially.

45 DESIGN OF CONCRETE AIRPORT PAVEMENT

Portland Cement Association—This 48-page booklet on the design of concrete pavement for airports presents design charts for determination of pavement thickness and concrete resurfacing. Also included are recommendations for jointing layout, the use of sub-base under concrete and the evaluation of existing pavements.
(Sent in U.S. and Canada only.)

46 DOCKS, WHARVES AND PIERS

De Long Corporation—A new 20-page, profusely illustrated booklet describes jacks and the De Long technique of dock construction, of which the famous Texas Tower is but one application. Other illustrated De Long installations include piers, wharves and drilling platforms. This colorful booklet gives the complete story of the company's techniques; predicts new applications to come.

47 DRAFTING MACHINES

V. & E. Manufacturing Co.—A new 15-page brochure gives detailed descriptions of such drafting machines as the vertical drafter, detail drafter, left-handed drafter, and formed & solid drafting machine scales. Information on how to select the proper size machine will be helpful to engineers and draftsmen. Also included is a price list.

48 DRAFTING PENCILS

J. S. Staedtler, Inc.—A new booklet, entitled "Why is Everyone Interested in Mars?" has just been issued. It describes in detail every product in the company's line, including Mars-Lumochrom, the new colored drafting pencil that blueprints perfectly.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

49 DRAIN GRATES

Irving Subway Grating Co., Inc.—A recently published four-page, two-color folder illustrating the use of open mesh steel flooring as drain grates is now available. The folder contains photographic illustrations and shows typical uses of drain grates. There are engineering drawings of the various types and complete technical data to facilitate estimates and specifications.

50 DRAWING BOARD ATTACHMENT

Spiroll Products Company—A new drawing board attachment constructed of non-corrosive steel is described in a new brochure. It protects drawings and enables the draftsman to work in the most comfortable position, while seated or standing. The brochure is complete with prices and illustrations showing how the device operates.

51 DRAWING INSTRUMENTS

V. & E. Manufacturing Co.—Has published a booklet describing their various drawing instruments and drawing sets. Among the instruments included are open-truss compasses, drop bow compasses, friction dividers, Vemco Velox beam compasses, erasers, and drawing leads. A price list is also given.

52 DRAWING MATERIALS

The Eberhard Faber Pencil Co.—A four-page catalog in full color pictures a complete line of drawing materials developed for use in the design or drafting room. This includes pastels, colored pencils, drawing pencils, leads and holders, erasers of every type and a host of other related items.

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Get a demonstration of the FORTY FIVE from your Allis-Chalmers dealer . . . let him show you how fully-enclosed power steering, accelerator-decelerator pedal, "box seat" comfort and visibility, and other features give you an extra measure of performance on all your grading jobs. Check the complete service program he offers you . . . factory-trained servicemen and True Original Parts for high-quality service, continued top performance and long equipment life.

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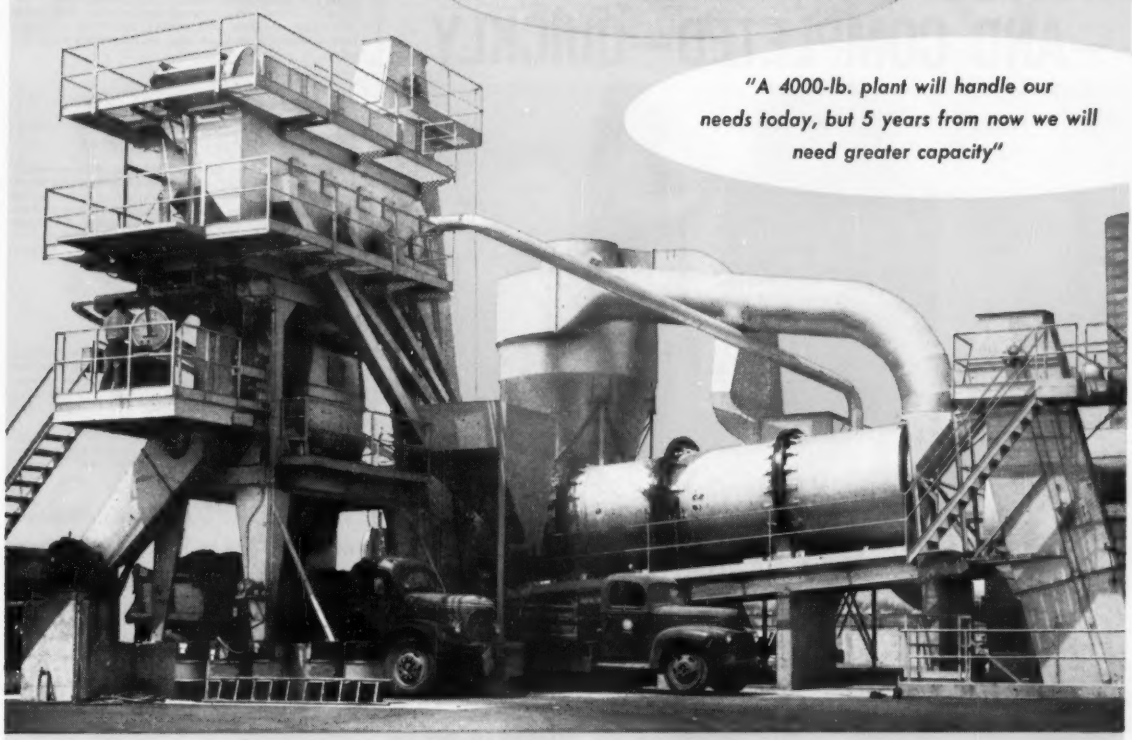
"A 5000-lb. plant will handle our requirements"

"A 4000-lb. plant will handle our needs today, but 5 years from now we will need greater capacity"



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Project: New Home Office building of Mutual Benefit Life Insurance Co., Newark, N. J.
Architects: Eggers & Higgins, New York City.
Engineers: Weiskopf & Pickworth, New York City.

Though superstructure plans were in the design stage, foundation work was under way for this largest Newark office building in 20 years. Photo shows a few highlights. In the structure at left, wall chases are planned for the erection of permanent steel before demolition takes place.

CATALOGUE ON REQUEST

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CATALOG DIGESTS

53 DROP PILE HAMMERS

Vulcan Iron Works, Inc.—Bulletin 66-D discusses in great detail drop pile hammers and other related items. Sections of the catalog deal with pile caps, sheaves, pile points, selection of hammer, efficiency of blow and safe bearing load for piles.

54 DUCT INSTALLATION MANUAL

Clay Sewer Pipe Association, Inc.—Completely illustrated, the clay pipe warm air heating duct installation manual is an authoritative guide for installing clay pipe heating ducts, for both perimeter loop and radial systems. Over 10-pages contain complete information and dimensions.

55 EARTHMOVING EQUIPMENT

Wooldridge Manufacturing Division—Bulletin No. 750, general catalog supplies basic information on a complete line of powdered and tractor-drawn scrapers and powered hauling units together with other earthmoving equipment.

There are 193 Digest items on pages numbered 134 to 160. Read all items for the literature of interest to you.

56 FIBRE FORMS

Sonoco Products Company—Sonotube fibre forms, as explained in a recent brochure, were developed to provide an economical method of forming round columns of concrete, also for pile encasement, both steel and wood. The brochure contains photos of actual job applications. Technical data is also available.

57 FLOOR ARMOR

Irving Subway Grating Co., Inc.—Just published is a new catalog on Gridsteel floor armor. Gridsteel is made of steel bars on edge, bent and joined together in a continuous hexagonal mesh pattern. Floors armored with Gridsteel last indefinitely. Gridsteel prevents ruts or potholes from forming, gives an even tractional floor surface at all times. Catalog illustrates uses, advantages, and shows how quickly and simply Gridsteel is installed.

58 FLOOR GRATINGS

Borden Metal Products Co.—A catalog containing technical information on how to select, design, purchase and install floor gratings, safety steps, and floor armour, available in steel, aluminum or stainless alloys, is offered. Safeload tables, step-by-step procedure for ordering, planning and checking is included.

59 FORMING EQUIPMENT

Symons Clamp & Manufacturing Company—An informative color catalog on forming equipment is being offered. The catalog gives general information on forming systems plus product illustrations. On-the-job photos show various types of forms, column clamps, shores, bar ties and other miscellaneous accessories.

60 FORM TIES

Universal Form Clamp Co.—A 32-page catalog describes and illustrates a complete line of form ties and concrete accessories.

61 FORM-TY DEVICES HANDBOOK

Richmond Screw Anchor Company—A new handbook designed to help contractors and engineers secure maximum speed and economy in concrete construction contains detailed working drawings, application data, safe load charts and spacing charts, etc. It is a useful guide in selecting the best tys and anchor for the particular job in any category: roads, bridges, tunnels, dams, water and sewage plants, buildings.

Return the coupon today!

62 FOUNDATIONS

Spencer, White & Prentis, Inc.—Has literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of pretest underpinning and the application of the pretest method.

63 GRADE-O-MATIC MOTOR GRADERS

Galion Iron Works and Manufacturing Company—A new bulletin on the world's largest motor grader has just been issued. Called the T-700, its Grade-O-Matic drive utilizes a torque converter, power shift transmission and tail-shaft governor. Specifications and diagrams accompany the data.

64 GEARS

The Earle Gear and Machinery Company—A twenty-page catalog describes in general, the kinds and sizes of gears manufactured by this company. Its contents deal with spur gears, bevel gears, helical gears, worm gears, racks, non-metallic gears, sheaves, sprockets, special machinery of which gears form a part, and special gear information. Illustrated with photographs, it also shows actual Earle installations.

65 GRAPHIC VISUAL CONTROL

Graphic Systems—Information or operations can be graphically displayed on the Boardmaster, which is described in a new catalog. Material is typed or written on interchangeable cards and then posted on an aluminum board. Information is easily kept up to date. This method is ideal for recording and illustrating engineering and construction data.

66 GRATING AND STAIR TREADS

Klemp Metal Grating Corporation—An illustrated report on the usage of steel, aluminum and stainless grating and stair treads includes a detailed safeload table with conversion factors, panel width constant chart and data on the standard widths and types of steel stair treads most frequently used. The brochure also discusses the various types of electro-forged welded grating as well as offering dimensional sketches and data on riveted grating.

67 GRATING FLOORING AND TREADS

Irving Subway Grating Co., Inc.—General Grating Catalog F400 contains illustrations, descriptions and complete engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types). Irving Grating is safe, durable, fireproof, ventilating, clean and economical for industrial and power plants and refinery walkways, stairways, driveways, trucking aisles.

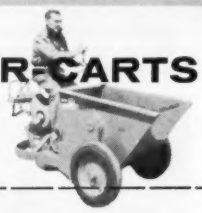
68 GRAVITY FILTERS

The Permutit Company—Bulletin 2539B describes in its 24-pages the complete line of gravity filters and filter accessories: manually operated, semi-automatic, including operating tables, rate of flow controllers and gauges. Specifications, operating instructions, outline dimensions and typical installation photographs have been included in this edition.

GAR-BRO Selection Chart

Equipment	Load Capacity	Maximum Travel Distance	Speed	Capacity* Per Hour
POWER-CARTS	9 to 12 cu. ft.	1000 ft.	15 mpr.	15 to 20 cu. yds.
CONCRETE-CARTS	6 to 8 cu. ft.	200 ft.	walking	3 to 5 cu. yds.
WHEELBARROWS	3 to 5 cu. ft.	200 ft.	walking	1 to 1½ cu. yds.

*according to hauling distance



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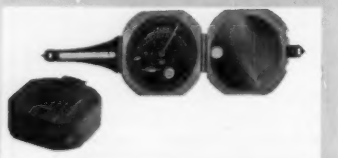

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CATALOG DIGESTS

69 GUNITE

Pressure Concrete Company—Has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and other data. A new leaflet just published illustrates pressure grouting to dams.

70 HIGH HEAT TREAT STEEL

Lockheed Aircraft Corporation in Burbank—A report on "High Heat Treat Steel," is taken from one of Lockheed's monthly engineering and manufacturing forums. The report summarizes some of Lockheed's experience with high heat treat steel and is one of the brochures offered career-conscious engineers by Lockheed's recruiting department.

71 HORIZONTAL FORM SUPPORTS

Universal Builders Supply Company, Inc.—The newest of all-metal adjustable supports used in suspended formwork is explained in literature now available. Called the S-L Spanall, it cuts the cost of concrete floor forms up to 40% and has a safety factor of 2.17. The ease of erection of these supports and detailed data are contained in the literature.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

72 HOT OIL HEATER

Wm. Bros Boiler & Mfg. Co.—A new 4-page folder illustrates and explains the features of the new Bros hot oil heater which includes: rapid heat transfer, coil furnace efficiency, "cold oil" seal feature, completely automatic operation and electric driven smoothness. It tells how the heaters are applicable to many industries where heating temperatures up to 600° F. are required and operation at atmospheric pressures are desirable. Reasons for lower operating and maintenance costs of the heaters are also presented.

73 HOW TO CORE DRILL

Acker Drill Co., Inc.—"Basic Procedures of Diamond and Shot Core Drilling" shows with over 80 illustrations and drawings the fundamentals of core drilling practice. Pipe driving, core recovery, core logging and storage are all covered in this pocket size book for the beginning driller. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Acker Drill Co., Inc.

74 HYDRAULIC CRANE

Austin-Western Works—An eight-page catalog, AD-2253, pictures and describes the new Austin-Western hydraulic crane. This tractor-mounted crane, with its pickup, carrying, and placement capabilities combines the best features of crawler, truck, and erection cranes with those of industrial shop cranes. All movements are actuated by fast, smooth, hydraulic control.

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PILING

Checking Foundations with 120-Ton Load on H-Bearing Frames Anchored to Foster Piling
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Contractors Webb & Knapp got a *Head Start* on this gigantic project by calling Foster for rental steel-sheet Piling, to complete four sumps (that were holding up the major excavation of this 400-foot square foundation). Foster delivered *on time*, the exact sections and exact lengths of steel-sheet Piling needed to get a head start on work schedules.

Foster 12"x 53 lb. H-Bearing Piles driven an average depth of 50 feet, around perimeter of the gigantic 400 foot excavation.

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How to Lay Pipe Down a City Street

The street you see in this picture is in a Toledo suburb, in Lucas County, Ohio. The pipe is a 16-foot length of prestressed concrete cylinder pipe, one of 941 pieces that were laid down residential and business streets of this area. Two pieces of equipment were used, a backhoe to dig the trench and lay the pipe, and a front end loader to backfill. This type of pipe installs quickly, even in below-freezing weather, because of the simplicity of the steel-and-rubber joint. Traffic was maintained during the entire job.

When a concrete line is laid through city streets, the manufacturer furnishes a supply of bevel adapters to permit the crew to make on-the-spot turns to clear obstructions. A bevel adapter is a small special made up of a bell ring and a spigot ring set back-to-back at an angle of 2° or 4°.

Concrete pipe is good for distribution and feeder lines like this one because of its strength. No concrete pipe has ever been known to shatter and flood a city street. For more information on how to lay concrete pipe, write Price Brothers Company, Dayton 1, Ohio.

Price

Symons FIELD REPORT...

Symons Forms, Shores and Column Clamps Used On 525 Ft. Aqueduct at Streator, Illinois...

to carry a 27-inch pipe across a ravine.

Symons solved the difficult task of setting up to pour concrete around the vitrified tile pipe, averaging 225 pounds per foot. Weight of pipe and poured concrete is over one ton per lineal foot.

Footings 7′ x 7′ and 1′3″ thick were first built for the concrete piers spaced 25 feet apart. Symons Column Clamps were used to form the piers—12″ x 24″ at the base, 12″ x 48″ at the top and range in height from 10 to 19 feet.

The aqueduct is 4′3″ wide and four feet high. Symons Forms with steel cross members and 51-inch ties were used to form the sides, which were supported by one set of walers.

Three-quarter inch plywood formed the beam bottom, resting on 4″ x 4″ joists. Girths 4″ x 6″ were spaced every four feet and supported by Symons Safety Shores. Warren & Pragg, Decatur, Illinois, was the architect and Central Ironite Waterproofing Company, Maywood, Ill., was general contractor.

Symons Forms, Shores and Column Clamps can be rented with purchase option, all rentals to apply on purchase price. Symons Clamp & Mfg. Co., 4291 Diversey Ave., Dept. D-6, Chicago 39, Ill.

View showing completed piers and aqueduct

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CATALOG DIGESTS

75 HYDRAULIC CUSHION

Boomsnub Company—A four-page catalog describes the Boomsnub, a hydraulic cushion engineered for maximum safety and efficiency on all types of cranes. The Boomsnub is an arm made of two telescopic steel tubes containing hydraulic oil. Sudden recoil causes a spring-loaded valve to open, allowing more oil to flow but providing enough resistance to bring the boom to a stop within 2 or 3-deg of rotation. The catalog contains a listing of endorsements of the Boomsnub by federal, state and industrial crane operators.

76 HYDRAULIC DATA BOOK

Leupold & Stevens Instruments, Inc.—Interpretative data on water measurement and control is at your fingertips in this 144-page revised edition, in three parts: float wells and instrument shelters; errors in float operated devices; hydraulic tables; plus pages for notes and memorandums. Indispensable for the engineer with its wealth of information, tables and illustrations, the price of the book is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.

77 INCREASING CRANE CAPACITY

Sauerman Bros., Inc.—Field Report No. 228 tells how to extend the reach of your crane and in many cases double its capacity with a Crescent scraper. A layout drawing illustrates the Sauerman method, and three pages of on-the-job photos support this promise of increased range and greater payloads. The report describes the advantages of scraper operation on certain jobs and offers an engineering service that will determine the largest size Crescent your machine can handle.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

78 INCOME PROTECTION FOR MEMBERS

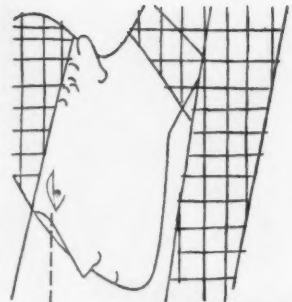
Smith & Sternau—A pamphlet giving full details on the societies' groups disability plan outlines the moderate rate and its many advantages and benefits. Specify membership grade on coupon.

79 INDUSTRIAL PRODUCTS CATALOG

Johns-Manville—Has issued a new edition of its 52-page catalog which offers essential data on the following groups of products: Insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, roofing, siding, flooring, partitions, and ceilings. Photographs, diagrams, and tests have been revised and brought up-to-date so that engineers and plant executives will have the latest information in a compact catalog that is easy to use.

80 INSULATION

Pittsburgh Corning Corporation—Samples of Foamglas insulation and a 12-page booklet explaining its properties and use are available. The Foamglas is inorganic and has a closed cellular structure which assures its being completely fireproof and waterproof.



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For MODERN, FUNCTIONAL Surveying Instruments.

Consistent research and experimentation result in constant improvement and simplification, practically eliminating instrumental errors.

KERN'S DKM I

Ten second Theodolite for land surveying, big construction and Engineering Operation.

FAST DIRECT READING To 10". Estimation to 1". All reading from 1 position.

COMPACT INSTRUMENT is highly portable. Weight 6 lbs. Height 7" including Metal Case.

Ask for detailed Brochure DK518-2

Kern SWISS

The FINEST in SURVEYING EQUIPMENT

KERN INSTRUMENTS INC.

120 Grand St., White Plains, N.Y.

CATALOG DIGESTS

81 JETTING PUMPS

Griffin Wellpoint Corporation—A booklet illustrates jetting pumps for pile and caisson jetting, oil pipe line testing, water supply and fire protection. The illustrations show unusual setups for high-pressure jetting, including parallel and series pumping arrangements.

82 JOBS DESCRIBED

Boeing Airplane Company—An extensive brochure is offered describing the roles of aeronautical, civil, electrical and mechanical engineers, mathematicians and physicists in the design, research and production of advanced commercial and military aircraft and guided missiles at this company.

83 JOINT SEALER

Sika Chemical Corporation—A brochure describes flexible non-meltable Igas joint sealer for water reservoirs, concrete tanks and deep basements. Specifications and architectural details are included on separate sheets.

84 KOMPACTOR

Buffalo-Springfield Roller Company—An eight page colored booklet explains the K-45 Kompactor. It is self-propelled, highly maneuverable, works on steep embankments, and close to abutments and culverts. The advantages of its reductions in time and cost estimates are fully outlined. Specifications accompany the data.

85 LAYING CONCRETE PRESSURE PIPE

Price Brothers Company—A pocket-size book of instructions for laying concrete pressure pipe via the backhoe method contains up-to-date instructions (with photos and drawings) of proper trenching, checking grade, handling pipe, and completing the flexible watertight rubber and steel joint. Also shows a check list of equipment and supplies needed for the job.

86 LAYNE BULLETIN

Layne & Bowler, Inc.—A 20-page bulletin, NA-55, features a partial list of national and international firms served by the Layne organization, world's largest water developers.

87 LONGSPAN JOISTS

Haven-Busch Company—The 1956 version of this 32-page catalog has just been completed describing the new series longspan joists SJI-AISC. It includes top chord extensions, graphs, maximum moment table, load carrying tables, panel dimensions, and other pertinent design data.

88 LONG-SPAN Q-DECK

H. H. Robertson Company—Full information on exceptionally long-span deck describes ease of handling and erecting for lengths up to 32 feet. Designed especially for schools, supermarkets and other structures where long, unbroken spans and structural steel savings are beneficial it contains structural details, load tables and specifications.

89 LOW BED TRAILERS

Birmingham Manufacturing Company, Inc.—Offers three brochures illustrating specifications on their machinery trailers. These brochures not only illustrate their standard lowbed and tilt units but show off-the-road equipment, special trailer chassis and oil field trailers. They have engineered units with capacities as high as 265 tons and offer special design engineering service.

90 MAPPING PRODUCTS

Fairchild Aerial Surveys, Inc.—A quick reference guide to Fairchild mapping products shows the materials and methods for producing different types of maps. Included are oblique and vertical photos, photo index and line index, controlled mosaic or photomap, topographic contour map, magnetic contour map, and radioactivity contour maps and strip chart.

91 MASONRY CEMENT

Lone Star Cement Corporation—A 16-page, illustrated booklet outlines the advantages of Lone Star masonry cement in simplifying the problem of obtaining uniformly high-quality mortar, as well as the economy of one rigidly standardized, ready-to-use cementing material instead of two with no lime or Portland cement to add, and no soaking or slaking. It provides timely information on soundness, low absorption, high water repellency and other factors contributing to durable, weather-resistant performance. It contains easily-read graphs showing effect of mix proportions on water retention, strength and absorption, effect of mixing time on water retention, along with convenient reference tables for estimating quantities.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

92 METERS, FEEDERS, AND CONTROLS

B-I-F Industries, Inc.—B-I-F 5 is a 12-page, two-color booklet which explains a varied line of equipment for metering, for chemical feeding and proportioning, and for controlling processes and operations.

93 METRIC WALL CHART

Mayo Tunnel and Mine Equipment—Simplified metric conversions, originally designed for the Mayo company office is now available. Chart includes: feet to meters; inches to meters; decimals of a foot; meters to feet plus other useful conversion factors. Illustrated are steel forms, tunnel shields, grouters and other equipment for the mining industry.

94 MINE, SHAFT AND INCLINE HOISTS

Superior-Lidgerwood-Mundy Corporation—The 16-page bulletin M515 describes and illustrates a full range of steam, electric, gasoline and diesel powered hoisting machinery which is "engineered and designed to suit," yet consists of standard parts. Also described are hoists for special purposes. Included are 36 illustrations of important installations; data required for estimating on mine, shaft and incline hoists; general information on mine hoists and hoists for shafts and slopes.

95 MOTOR GRADER

Allis-Chalmers Manufacturing Company—The design, engineering, construction and performance story of the 50-hp Model D Motor Graders is comprehensively told in a 16-page catalog. Cut-aways, combustions, graphs and other illustrations help the reader visualize features of both the gasoline and diesel engines. Photographs also show the many features that assure operator comfort and safety.

96 MOTOR SCRAPER

Allis-Chalmers Manufacturing Company—Engineering, design, construction and mechanical features of the new TS-360 motor scraper that make it a big capacity earthmoving unit are outlined in a new two-color catalog. Photographs and drawings assist the reader to understand better the many advances incorporated in this 20-cu yd heaped or 15-cu yd struck capacity scraper powered by a 280-hp diesel engine.

97 MOTOR SWEEPER

Austin-Western Works—A 16-page catalog describes the motor sweeper. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in this catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

98 NEW CONTRACTION JOINT

Armco Drainage & Metal Products, Inc.—A 3-page Application Bulletin plus drawings describes a new type of contraction joint that permits full joint rotation while still providing maximum load transfer. Other advantages are watertightness, ease of installation, freedom from maintenance, control of cracking, smooth riding quality, and economy. The new product is known as Armco smooth-ride contraction joint. It has been used by the Texas State Highway Department for four years and fulfills approximately 90 per cent of their requirements.

99 PENCILS

Eagle Pencil Company—A 16-page booklet tells how to choose the right pencil for every job, and discusses general writing pencils, colored pencils and a number of specially designed pencils for special tasks. There is a special section of interest to the draftsmen.

100 PENCIL SAMPLE KIT

American Pencil Company—The Venus blueprint pencil sample kit is available. With specially formulated lead, the pencils give clear, non-smear markings on all blue or white prints and coarse papers. The Kit includes two new Venus blueprint pencils and a drawing pencil.

101 PHOTOELASTIC POLARISCOPE

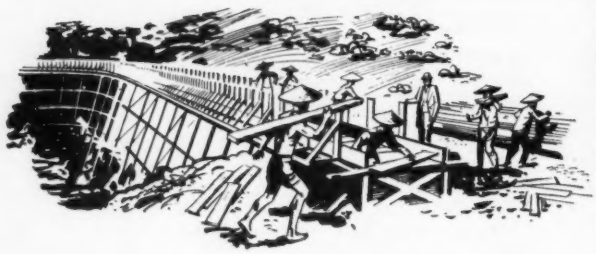
Polarizing Instrument Co., Inc.—A new catalog describing new apparatus is now available. Four new Polariscopes and two straining frames are featured.

Return coupon on page 134

Reinforced concrete pipe by American Pipe and Construction Co.

...45 years young!

for the La Mesa, Lemon Grove and Spring Valley Irrigation District



It's a far cry from the wooden flume built by Chinese coolie labor in 1888 to the 42″ American Centrifugal Concrete Pressure Pipe main supply line of today which provides water for the La Mesa, Lemon Grove and Spring Valley Irrigation District. This line and others, supplied by American Pipe and Construction Company to this pioneer irrigation district for the past 45 years, assure ample supply and sustained carrying capacity for years to come. They will help this forward-thinking irrigation district meet tomorrow's demands from a community that has increased its population 1400 per cent in little more than a generation.

To make sure your water system meets tomorrow's challenge, take advantage of the low cost quality available to you through American Reinforced Concrete Pipe. Whatever your needs, you'll find a class of American Pipe designed to meet your requirements. Product information is available to you from engineers who know from experience and tests what each class of pipe will do. Write or phone for additional information.

5602

American PIPE AND CONSTRUCTION CO.

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous lines

Mail address: Box 3428 Terminal Annex, Los Angeles 54
Main offices and plant: 4635 Firestone Blvd., South Gate, Calif.—LOgan 8-2271
District sales offices and plants: Hayward and San Diego, Calif.—Portland, Ore.

The man behind the gun will tell you...

WHITE GIVES YOU

greater, longer-lasting precision...

Shown, model 7014 with "A" standard. Model 7014 same unit with "U" standard, also available.

yet costs less than other quality engineers' transits

LIKE every White quality-built instrument, these engineers' transits give you greater dollar-for-dollar value than any other comparable unit.

For example: White uses a recently-developed Swiss Dividing Engine to cut graduations into solid silver. This insures super-precision from the beginning, safeguards it through more years of hard field usage.

In addition, White engineers' transits give you internal focusing, covered leveling screws and coated optics. These and a host of other design and operating features combine to give you a transit unsurpassed for ease, speed, accuracy, economy and long-lived dependability. Write for Bulletin 456 and the name of your nearest dealer. DAVID WHITE COMPANY, 309 W. Court Street, Milwaukee 12, Wisconsin.

DAVID WHITE COMPANY

We offer expert REPAIR SERVICE on all makes, all types of instruments

CATALOG DIGESTS

102 PILE EXTRACTORS

Vulcan Iron Works, Inc.—The pile extractor, a compact and inexpensive machine expressly designed for pulling sheet steel, wood, concrete, H-beam and pipe piles, is described in Bulletin 71-C. Specifications, a list of duplicate parts and on-the-job photos are included in the catalog.

103 PILE REPAIR

Masonry Resurfacing & Construction Co., Inc.—An eight-page illustrated pamphlet is offered describing the Dri-Por system of pile repair and encasement. The pamphlet describes the application of the Dri-Por system to the repair of the 5-mi James River Bridge system near Newport News, Va. Also included is a description of the Dri-Por K-box which allows repair of concrete piling in the dry, and high quality repair for wood and steel.

104 PILES

Raymond Concrete Pile Company—Standard and step-tapered piles are described in Catalog S-56 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation. Domestic operations include harbor and waterfront construction, and cement-mortar lining of pipelines in place. Raymond's services abroad also include all types of general construction.

105 PILES

The Union Metal Mfg. Co.—Catalog No. 81 on Monotube piles, in addition to general descriptive information, contains engineering data covering physical properties, specification suggestions and test loading; also, contractor data on concrete volumes and weights. It includes numerous photos showing a wide range of job applications throughout the country. Advantages listed: light weight, easy handling, economical field extendability, visual inspection after driving, highload carrying capacity with extra high economy per ton load supported.

Return the coupon on page 134

106 PIPE CLEANING UNIT

Miller Sewer Rod Company—A new pipe cleaning unit designed for cleaning out drain stoppages quickly is described in a brochure now available. Once the speed handle is turned on the rod will whirl down the pipe cleaning out sand, grease, rags and other obstructions. A list of partial users of the rod is included in the brochure.

107 PIPE MANUAL

Clay Sewer Pipe Association, Inc.—The new clay pipe engineering manual contains engineering reference data applicable to the design and construction of sanitary sewer systems and related construction. The 189-pages of authoritative information are completely indexed and spiral bound in a leatherette cover.

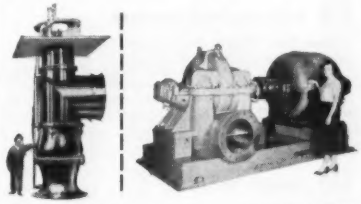
108 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc.—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by an instrument weighing only $8^1/_2$ ounces.

YOU NAME THE PURPOSE WE MAKE THE PUMP

For every specific need from the smallest to the giants of 200,000 GPM capacity — Highly specialized engineering and manufacturing for over 40 years assures freedom from maintenance worries — Many users report 15 to 20 years service without replacement of major parts.

WHEELER-ECONOMY PUMPS



VERTICAL AXIAL FLOW FOR CIRCULATING CONDENSER COOLING WATER

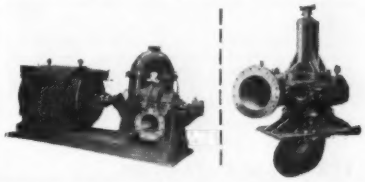
DUAL VOLUTE FOR MUNICIPAL WATER WORKS

WHEELER-ECONOMY PUMPS

HORIZONTAL NON-CLOG FOR SEWAGE, TRASH, STOCK

DUPLEX, SUBMERGED NON-CLOG FOR SANITATION SEWAGE, INDUSTRIAL WASTE

WHEELER-ECONOMY PUMPS



TWO-STAGE DMD HIGH HEAD FOR MUNICIPAL & INDUSTRIAL SERVICE

VERTICAL MIXED FLOW FOR IRRIGATION, DRAINAGE, FLOOD CONTROL, SEWAGE

WE-500

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Division of

C. H. WHEELER MANUFACTURING CO.

ECONOMY PUMPS, INC. • DIVISION OF C. H. WHEELER MANUFACTURING CO. 19TH AND LEHIGH, PHILADELPHIA 32, PA.

CATALOG DIGESTS

109 PORTABLE GASOLINE RAMMER

Barco Manufacturing Company—Offers an eight-page catalog describing the Barco portable gasoline rammer for soil compaction. This tool is the only successful mechanical means of obtaining specified soil compaction in restricted areas such as in trenches and near walls and bridge abutments. It is easy to operate, safe, and will compact 20 to 30 cubic yards of fill per hour where high degree compaction is specified. Barco also offers a bulletin "Cost Data for Soil Compaction in Restricted Areas with the Barco Rammer" of interest to all earthmoving contractors.

110 PORTABLE PILE HAMMER

Vulcan Iron Works, Inc.—Eight pages of a two-color catalog describe the new DGH-100 portable pile hammer. This new hammer is differential-acting, and operates economically on compressed air, or steam. A list of parts and specifications is included in Bulletin 30.

111 POWER GRADERS

Austin-Western Works—A 20-page catalog, AD-2295 pictures and describes the complete new line of power graders with exclusive all-wheel drive and steer. All types of work are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

112 POWER RATING CHART

Waukesha Motor Company—In Bulletin 1079-B complete tabulations are given for dynamometer horsepowers with complete speeds and loads for all types and sizes of diesel, gasoline and natural gas engines. Ratings are in accordance with standards of the Internal Combustion Engine Institute.

113 POWER SCRAPER

Wooldridge Manufacturing Division—Bulletin No. 1500A contains information and pertinent specifications on the Cobrette, a new 10-yd powered scraper.

114 POWER UNIT

Allis-Chalmers Manufacturing Company—A new eight-page, two-color catalog, which gives the design and performance story of the four-cylinder 60-hp W-226 power unit, includes specifications, cut-away views of the power package, and photographs of the fan to flywheel unit. Special and extra equipment that increase the versatility and use of the power unit is also listed.

115 PRECAST FLAT-BASE PIPE

American-Marietta Company—This pamphlet contains many photos and drawings showing the great versatility of flat-base pipe. Also included in the folder is a chart giving complete data on sizes and weights available.

116 PRECIPITATOR

The Permutit Company—Bulletin No. 2204C is a well-illustrated and documented 20-page pamphlet describing the many applications, principles of operation, design features, advantages, recommendations, flow diagrams and specifications of Permutit's precipitator. The precipitator offers, through its three basic designs, an efficient means of removing impurities from a liquid by precipitation, absorption, settling and filtration. Chief uses are in water softening, the reduction of alkalinity and the removal of turbidity, color, taste, odor, silica and fluoride.

117 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—An informative, 4-page brochure, combining a catalog and calculating chart has been prepared. Pictured in four colors on the cover is the Berger Type R transit, one of the many instruments produced by the 85 year-old firm. On the center spread are photographs and code names for 12 types of Berger instruments, from an 18-in. dumpy level to a plane table alidade.

118 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—Complete specifications on the Berger line of moderate priced builders' instruments are included in an illustrated brochure now available. Companion line to the company's engineering, mining and astronomical instruments, the line consists of a convertible transit-level, a 12-in. heavy-duty dumpy level, a service transit level (farm level), a hand level and optical tilting level.

119 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—"Solar Ephemeris and Polaris Tables," 1956 Edition, 96 pages, contains complete instructions for determining azimuths from the sun and the altitude of Polaris, has been prepared by Herman J. Shea, Associate Professor of Surveying, Massachusetts Institute of Technology. Directions for making astronomical observations and computing results by direct solar observation and time from same observation: meridian by solar attachment; meridian by Polaris at elongation; azimuth by Polaris at any hour angle; latitude by sun at noon, and latitude by Polaris are included, as well as all requisite tables. Price is $.50 per copy.

N. B. There is a charge for this book. Make checks payable to C. L. Berger & Sons, Inc.

There are 193 Digest items on pages numbered 134 to 160. Read all items for the literature of interest to you.

120 PRECISION TRANSITS

Warren-Knight Company—A four-page colored booklet describes Series 2 and 4 precision transits, both with 360-deg full vertical circle and internal focusing. The Series 2 comes with compass, while the No. 4 is without compass. Detailed specifications, price list and features of advantage conclude the brochure.

121 PREPARATOR AND ROTO-MIXER

Wm. Bros Boiler & Mfg. Co.—A two-color brochure announcing two new pieces of road construction, the preparator, in-place material reducer, and the roto-mixer, a blending and stabilizing unit for all types of materials, is available. The folder illustrates four ways the preparator will reduce road materials costs. The roto-mixer features independent control of rotor and hood to provide positive mixing depth control to any given depth up to the maximum depth of 24-in. To complete the team, the folder also illustrates the new self-propelled rubber tired tractor.

122 PRESSURE FILTERS

The Permutit Company—Bulletin 2225B describes Permutit's extensive line of pressure filters and their accessories. Specifications, operating characteristics, outline dimensions and typical installation photographs have been included in this edition.

123 PRESTRESSED BRIDGE MEMBERS

American-Marietta Company—This brochure shows with photos and blueprints how Amdek prestressed, pretensioned concrete bridge members are constructed. Weights and depths of beams are given, as well as the results of load tests. Illustrations show bridges under construction and completed Amdek installations.

124 PRESTRESSED CONCRETE TANKS

The Preload Company, Inc.—The first of a series of new booklets describes the design, uses and advantages of prestressed concrete in modern construction. The contents of this 24-page colored manual include evolution and use of concrete, and design, construction and specifications for concrete tanks. While the manual describes, in particular, the construction and sphere of usefulness of tanks, the advantages and economy of prestressed concrete design are equally applicable to all manner of pressure and load bearing structures, such as bridges, building frames and airport runways.

125 PRICE LIST

Clipper Manufacturing Company—The current price list includes specifications of standard and super hp masonry saws, accessories, concrete saws, and abrasive, diamond and break-resistant polka-dot blades. Colorful folders are available describing the powerful new Model C-360, 36-hp concrete saw, and the 25 and 14.6-hp concrete saws. A hot-pour Model AC-40 joint sealer, and cold-applied Models CP-400 and CP-300 are described in circular 6004. Also listed are the 27 direct factory branches.

126 PUMPS

C. H. Wheeler Manufacturing Company—Economy type M pumps for medium and high head services are described and illustrated in a new eight-page bulletin. Their advantages of high efficiency and low maintenance are described, and cross sections of design are shown for bottom suction and side suction types. Construction details are included.

127 REPRODUCTION MATERIALS

Eastman Kodak Company—This brochure features the company's several reproduction papers and tells how they work. List prices and sizes of the Kodagraph materials and chemicals are included along with a reproduction materials selection chart to help in the selection of the material best suited to any reproduction job.

128 ROLLERS

Buffalo-Springfield Roller Company—Three-wheel rollers with powered hydraulic roll brakes and tapered roller bearings on all rolls, an exclusive performance feature of these rollers, is described in a 10-page catalog. Made for heavy-duty, they are variable in weight; the two models range from 10–14 tons and 12–15 tons.

129 ROLL-O-MATIC TANDEM ROLLER

Galion Iron Works and Manufacturing Company—A new catalog on an advanced type of tandem roller drive called Roll-o-Matic, which utilizes a torque converter is available. This new drive sets a new standard of effective driving power and accomplishes worthwhile reductions in fuel consumption, mechanical wear, and maintenance.

8 Reasons Why UNI-FORM

Panels are the most widely used Prefabricated Form in the Industry

VERSATILITY

Uni-Form Panels will form straight, irregular, curved, battered walls . . . slabs, beams, columns, piers—everything from small house foundations to massive concrete structures.

COMPLETE— READY TO USE

The Uni-Form Panel System is complete, ready to use when it reaches the job. Eliminates field fabrication. Result: FASTER JOB STARTS.

FAST ERECTION

Simple assembly of easy to handle panels increases productivity of labor. Form more contact area per man hour with Uni-Form Panels.

AUTOMATIC ACCURACY

Assembly of Panels with Uni-Form Ties furnished for any wall thickness insures automatically accurate forming. Tie positively locks and spreads panels. No measuring . . . no guesswork.

LUMBER SAVINGS

You use less lumber in Uni-Forming. Steel-framed panels erect into a tight, rigid form requiring minimum alignment and bracing on 1 side only—regardless of height. Saves labor too.

FASTER STRIPPING

Less alignment and bracing lumber . . . fewer parts to remove means faster stripping, lower costs.

LONG LIFE

Rugged steel frame designed for fast pouring, cradles and protects plywood edges . . . permits maximum re-usage of plywood (actually 50 times or more) before replacement is necessary. Minimum panel maintenance required . . . lower material costs.

EXPERT ENGINEERING SERVICE

Universal's engineering staff and field engineers provide competent, specialized assistance, backed by over 40 years of experience in concrete forming.

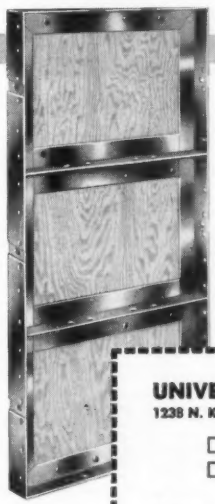
Branch Offices and Warehouses at: Los Angeles • San Leandro, Calif. • Houston, Texas • Cleveland, Ohio • Baltimore, Md. • Atlanta, Ga.

3 SIMPLE STEPS FOR ASSEMBLY

1. Insert Tie loop in Panel tie hole.

2. Tie Key locks Uni-Form Tie to Panel.

3. Tie loop receives adjacent Panel. Insertion of Tie Key completes tieing, locking and spreading operation.



3 BASIC ELEMENTS

UNI-FORM PANEL . . . Heavy duty — steel-framed, plywood faced.

UNI-FORM TIE . . . High strength, easy break-back.

UNI-FORM TIE KEY . . . Wedge shaped for fast, easy insertion and removal. Reusable.

UNIVERSAL FORM CLAMP CO.
1238 N. Kostner Avenue • Chicago, Illinois

☐ Send me complete details on UNI-FORM Panel System.
☐ SHOW ME! I am sending plans under separate cover.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

CATALOG DIGESTS

130 ROLL-ON JOINT PIPE

American Cast Iron Pipe Company—An illustrated brochure contains weight and dimension tables, installation photographs and instructions for assembling roll-on joint pipe.

131 SAFETY AND RELIEF VALVES

Lunkenheimer Co.—A two-color illustrated folder, Circular 502, describes the uses, performance, sizes, and installation of bronze pop safety and relief valves for steam, air, gas, water, oil and other liquids. The folder includes tables of relieving capacities.

132 SCREENING EQUIPMENT

Link-Belt Company—The complete Link-Belt line for efficient removal of solids from water, sewage and industrial waste is described in the 28-page book, No. 2587. Dimension and specification data for four types of coarse screens and three types of fine screens, plus tables to determine the proper size unit handling various capacities, are given.

133 SEALING PRESSURE LEAKAGE

Sika Chemical Corporation—A brochure describes quick-setting compounds and methods for use in sealing pressure leakage, through concrete and masonry in tunnels, tanks and deep basements.

134 SEISMIC SURVEYS OF THE SUBSURFACE

Geophysical Survey Division of Gahagan Dredging Corporation—A 13-page loose-leaf report with related technical article reprints, covers the seismic survey work done by the company for engineers in the planning and construction of highways, power plants and other buildings, dams, bridges, airfields, tunnels and water supplies.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

135 SELF-PROPELLED ROLLER

Wm. Bros Boiler & Mfg. Co.—A 2-color brochure describes the Bros self-propelled pneumatic tire roller, the SP-54, first all-rear-wheel drive roller with every pair of wheels oscillating. It illustrates the outstanding Bros design features especially engineered for smooth, fast, and economical operation on mat surfacing, seal coating and compaction jobs in the standard lift range.

136 SELF-REDUCING PLANE TABLE ALIDADE

Kern Instruments Inc.—A new brochure gives exact details about the new self-reducing plane table alidade. This completely new instrument eliminates use of slide rule, offset scale and dividers. Actual working experience shows time in field cut by 50%.

137 SELF-WIDENING FINISHING MACHINE

The Flexible Road Joint Machine Co.—The new Flex-Plane Detroit special self-widening finishing machine permits a paving contractor to finish tapered lane construction without setting up a third line of forms. A complete description of this machine and its many features are found in the bulletin, which shows the machine in operation on many of the major expressways, toll roads and super highways under construction at the present time.

138 SLIP FORM WORK

The Master Builders Co.—An eight-page illustrated bulletin containing job reports on slip-form work tells how Pozzolith was an aid in producing concrete of desired qualities. In addition, it describes control of setting time to speed construction and other Pozzolith benefits resulting from improved control of water content, entrained air and rate of hardening.

139 SLUDGE BED ENCLOSURES

Metropolitan Greenhouse—All-aluminum sludge bed glass enclosures, that are maintenance-free and superior to wood construction, are described in a new bulletin. Scientifically designed, these time-tested and proven alloys assure the ultimate in economy and durability for sludge bed enclosures. Plans, designs and specifications for all purposes are included in the bulletin.

140 SLUICE GATE

Rodney Hunt Machine Company—The first basic improvement in sluice gates in many years, the patented HY-Q flush bottom closure sluice gate, is described in Catalog 75. The newly released booklet, with 12-pages of illustrations, clearly shows all details of construction, installation, and operation of the unique gate as used in water filtration plants, power plants, municipal and industrial plants, drydocks, and flood control. Diagrams and text explain the many practical advantages offered by the HY-Q gate for water flow control. Complete recommendations for selection of frames and other equipment for sluice gates, as well as detailed specifications, series numbers, and clearance dimensions are also given.

141 SOIL SAMPLING TOOLS

Acker Drill Co., Inc.—Acker Bulletin 25 covers a wide group of soil sampling and foundation test boring tools. All standardized equipment and some special equipment for soil sampling is listed. Sixteen pages with over 60 illustrations.

142 SOIL SOLIDIFICATION

Manu-Mine Research & Development Co.—"The Science of Soil Solidification" is the title of a new 10-page bulletin. Contents include a detailed explanation of what soil solidification is, the methods employed, and solidified soil characteristics. In addition, one section of the brochure deals with the applications of the process to highways, mines, foundations, piers, dams and piling.

143 SPECIAL FOUNDATION SERVICES

Intrusion-Prepakt, Inc.—This catalog contains detailed information on cofferdam seals, bearing and cut-off piles, foundation and soil stabilization, and structural concrete repairs. Specifications and diagrams are included. A list of other special services, main and regional offices as well as foreign representatives are given.

144 SPECIAL PLATE STRUCTURES

Chicago Bridge & Iron Company—A 24-page brochure describes the Company's engineering, fabricating and erection facilities. The many technical services and special facilities available to the customer are also set forth here. The brochure contains illustrations of structures both under construction and after erection.

145 SPEED REDUCERS

The Earle Gear and Machinery Company—A sixteen-page illustrated catalog, describing speed reducers as applied to operating machinery, particularly bridge machinery, is available. Outlined are specifications, service factors, horsepower ratings and dimensions of the particular units illustrated. Gasoline power units are also dealt with in a compact, easy-to-read form. Photographs are shown of actual installations with miniature blueprints included.

146 SPIRALWELD PIPE . . . COUPLINGS

Naylor Pipe Company—Bulletin No. 507 covers data on large diameter light-weight pipe for ventilating lines, air and water lines, irrigation pipe, etc. Sizes 4 to 30 inches in diameter includes standard fittings and welding flanges; also details on one-piece wedge-lock couplings.

147 STA-BILT ROAD

Seaman-Andwall Corporation—A 21-page brochure is offered that combines standard and accepted stabilization procedures to attain new and much higher standards of load bearing value and permanency for every traffic demand. The combination involves for the most part only low cost local materials, and provides a much higher type of base in each classification. Bases have the advantage of rigidity and flexibility, a combination obtainable in no other pavement.

148 STANDARD PRODUCTS CATALOG

Link-Belt Company—A 340-page guide to one of the most complete standard lines of power transmission and conveying equipment is now available. This indexed book contains information for the engineer or layout man in selecting standard products for new installations or for replacements. It includes data on the line of chains for conveying and power transmission, ball and roller bearings, enclosed gear drives, clutches, gears, couplings.

149 STEAM PILE HAMMER

Vulcan Iron Works, Inc.—The 27-pages of Bulletin 68-D describe single-acting steam pile hammers. Operating at a medium steam pressure, they deliver a moderate frequency of low velocity blows from a relatively heavy ram. A table of recommended sizes for driving various types of piles is given.

150 STEEL FLOOR ARMOR

Klemp Metal Grating Corporation—An illustrated booklet describing the uses of steel floor armor to prolong the life of floors has been recently published. This new brochure shows both the application and installation of Hexteel heavy duty floor armor and Floorsteel flexible type floor armor through a number of simplified illustrations and engineering data. Included in this report are complete detailed specifications for both types of armour and instructions for determining the size armor which should be used for each specific installation.

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IN EVERYTHING RELATING TO DIAMOND CORE DRILLING AND SOIL SAMPLING

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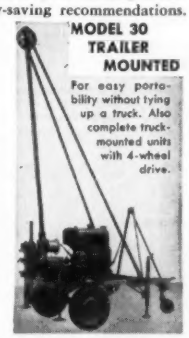
NEW LIGHT-WEIGHT HIGH-SPEED CORE-DRILLING MACHINES MODEL 30 AND MODEL L-2

Supplementing our well-known line of heavy-duty machines for large-diameter and deep-hole drilling we now offer two light-weight high-speed-core drilling machines suitable for either Skid, Trailer or Truck mounting. Both models can be powered by either gasoline or diesel engines and air or electric motors. Easily moved from one location to another, they can also be relied upon to produce good smooth cores rapidly at minimum expense. Complete illustrated information furnished on request.


MODEL 30
TRAILER
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For easy portability without tying up a truck. Also complete truck-mounted units with 4-wheel drive.

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We manufacture a wide variety of accessory equipment for diamond drilling and soil sampling and carry all essential items in stock for prompt delivery. A NEW CATALOG, No. 400, not only illustrates and describes each item but also gives piece numbers and shipping weights. Write to day for a free copy; it will help you to save time and money.

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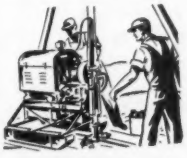

For more than seventy years, Sprague & Henwood, Inc. has been a leader in the field of Contract Diamond Drilling and Soil Sampling. During this long period of time our crews have completed thousands of contracts successfully, under every conceivable operating condition. Today, we have a large force of expert operators and an ample supply of modern equipment, so that we can undertake practically any job anywhere, on short notice. Inquiries for all types of contract drilling work are solicited — estimates submitted promptly without charge or obligation.

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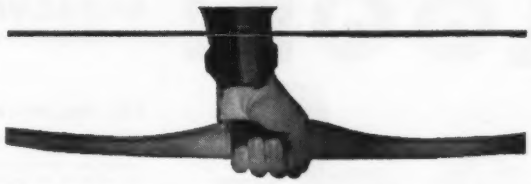

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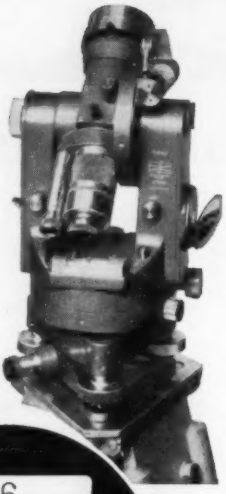

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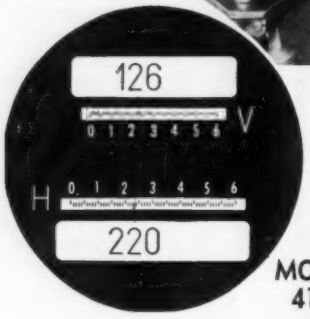

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F/S REPEATING OPTICAL TRANSIT

DIRECT *Vertical & Horizontal Reading*

Eliminates verniers, reading glasses, parallax errors, and stepping around instrument. A glance into the microscope eyepiece gives both vertical and horizontal readings directly to 1' with estimation to 6".

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Eliminates plumb bob and the delays due to swing and wind action. Looking into plummet (as diagram shows) operator sees plummet circle and ground point.

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Speeds repetition. Prevents errors.

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CATALOG DIGESTS

151 STEEL FOR HIGHWAYS

Bethlehem Steel Company—This 36-page illustrated booklet, "Steel for Highways," describes the broad range of Bethlehem steel products used in the construction of a modern highway. These include reinforcing bars, bar mats, dowel units, structural steel, wire rope, drill steel, pipe, guard rail and posts, fence and fence posts, sheet piling and H-piling, culvert sheets, rock anchor bolts, etc.

152 STEEL PRODUCTS

Connors Steel Division, H. K. Porter Company Inc.—A four-page brochure describes various steel products made by this company. Among these diversified products are reinforcing bars, structural shapes and highway sign posts. Illustrations of actual installations accompany the data.

153 STRUCTURAL ARC WELDING

The Lincoln Electric Company—A continuing series of studies—how arc welding is used in modern structures is issued periodically. Case histories of welded bridges, buildings and miscellaneous structures: drawings, details and calculations for typical structures are included. Current series is a study of school buildings.

154 SURVEY DEPTH RECORDER

Edo Corporation—A four-page brochure describes the Model 255 survey depth recorder, an extremely accurate echo sounder which measures depth of water in eight overlapping ranges, from 0 to 250-ft or fathoms.

155 SURVEYING INSTRUMENTS

C. L. Berger & Sons, Inc.—A 16-page condensed catalog, "Accuracy in Action," illustrates the engineering and surveying instruments manufactured by the company. General characteristics, optical systems and accessories for the Berger line of engineers' transits, levels, mining transits, theodolites, collimators and alidades are fully described with essential specifications for each. A section devoted to builders' and contractors' instruments is also included.

156 SURVEYING INSTRUMENTS

Charles Bruning Company, Inc.—Brunson engineering transits and levels, which incorporate patented dustproof ball-bearing construction, are described in a brochure now available. The brochure describes how use of the ball bearing principle prevents costly maintenance, eliminates looseness in bearings, and permits operation in temperatures ranging from 70-deg below zero to 160-deg above zero. It also illustrates various models of instruments.

157 SURVEYING INSTRUMENTS

Fennel Instrument Corporation of America—A folder on their line of precision instruments is offered. Photographs, detailed descriptions of the models and prices are included.

158 SURVEYING INSTRUMENTS

Kern Instruments, Inc.—A 32-page brochure offers a brief description of the most important instruments manufactured by Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are theodolites, levels, self-reducing tacheometers, alidades, pentagonal prisms and many other instruments.

CHEMICAL SOIL SOLIDIFICATION

TO STOP

• **UNDERGROUND WATER FLOW**
into Shafts, Heavy Building Pits, Structures

TO STOP

• **SETTLEMENT of FOUNDATIONS**

TO SEAL

• **LEAKY CONCRETE STRUCTURES**
by "Chem-Seal" Pressure Grouting

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TUNNEL & SHAFT LININGS, MINES, UNDERGROUND STORAGE CHAMBERS

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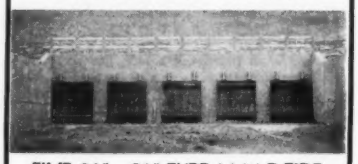
TIDE GATES



FIVE 96" x 96" TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

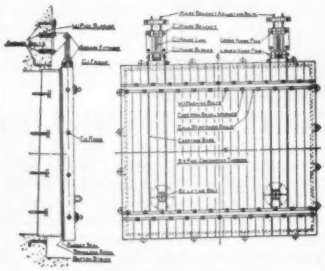


FIG. 9320 SHOWING TYPICAL CONSTRUCTION.

BULLETIN NO. 74—15 AVAILABLE UPON REQUEST.

BROWN & BROWN, INC.
LIMA, OHIO, U.S.A.

159 SURVEY MARKERS

Copperweld Steel Company—This four-page leaflet introduces non-rusting survey markers which will locate survey points permanently. Each marker consists of a steel core to which a thick copper covering is molten-welded. A new adapter available for the bronze-head marker provides an extra-large surface for stamping identification. The leaflet provides specifications and explanatory photographs.

160 TAMPERS

Wm. Bros Boiler & Mfg. Co.—Brochure RE-140 covers tampers in medium and giant weights. Single, double and triple drum models are listed. Standard sheepfoot tampers and standard diamondfoot tampers with relief shank are shown, also the Tamprite feet with replaceable Tamprite tips.

161 TANDEM ROLLER

Buffalo-Springfield Roller Company—A 12-page colored folder describes two-axle tandem rollers, which come in four different models ranging from 5 to 16-tons. With power roll brakes, superior vision design and bevel gear final drive, each feature of these rollers is fully explained in the catalog.

162 TAUTLINE CABLEWAYS

Sauerman Bros., Inc.—This new 3-color catalog illustrates cableway applications that will be of interest to civil and consulting engineers, public utilities and industrial concerns. Sixteen pages of photographs, sketches, and text describe types, spans, working loads and other details of tautline cableways.

163 TECHNICAL DATA CATALOG

Lefax Publishers—A newly revised 1956 catalog of pocket size technical data books is announced. These handy pocket books cover every field of engineering. The books contain about 140 loose leaf pages of up-to-date material, concise, comprehensive and authoritative. Partial listing includes surveying, tables, highway engineering, general math, trig-log tables, reinforced concrete and piping data.

164 THEODOLITE

Geo-Optic Company, Inc.—A leaflet describes the optical universal theodolite Askania TKT Transit with terrestric telescope (erecting eyepiece). The Askania TKT Transit enables surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

165 THREE-AXLE TANDEM ROLLER

Buffalo-Springfield Roller Company—The KX-25E tandem roller is featured in a new catalog. With exclusive walking-beam compaction control, the KX-25E is a heavy duty 3-axle tandem giving extra compaction where and when needed. Dimensions, specifications, weights, compressions chart and cut-away diagrams are included in the catalog.

166 TRANSITS

W. & L. E. Gurley—The complete line of surveying, and engineering instruments, including transits, levels, alidades are described in Catalog 50. The bulletin includes a cross-sectional drawing of the Gurley precise transit. Transits described include the hell gate precise transit; standard precise transit; the Gurley telescopic solar transit; the standard precise mining transit; and the optoplane precise transit for industrial use.

167 TRIPODS FOR SURVEYING INSTRUMENTS

Kern Instruments, Inc.—An illustrated pamphlet describes new tripods manufactured by Kern & Co., Ltd., of Aaran, Switzerland. These tripods greatly facilitate centering and setting up over a point.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

168 TOPOGRAPHIC MAPPING

Alster & Associates, Inc.—This brochure explains the photogrammetric method of mapping and analyzes the uses and advantages of topographic, planimetric and mosaic maps. In addition, the various services offered by this company are described. They include large-scale mapping by the photogrammetric method, aerial photography, and overseas mapping using any measuring system or language desired.

169 TUNNEL & MINE EQUIPMENT

Mayo Tunnel & Mine Equipment—A newly published catalog comprehensively depicts all-steel forms and various types of tunnel haulage and mine shaft equipment. Detailed descriptions and pictures accompany the data.

170 TUNNELS

Spencer, White & Prentis, Inc.—"Famous Subways and Tunnels of the World," by Edward and Muriel White recounts the fascinating history of subways and tunnels from earliest times. The price is $2.75.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

171 TURBINES

The James Leffel & Co.—Bulletin 1094-E is a thorough progress report on the successful installation and testing of a vertical shaft plate steel spiral case turbine made by this company. The installation was at the Nottely plant of the Tennessee Valley Authority. Turbine rating was 21,000-hp, 180-rpm, and 124-ft head.

172 UNDERPINNING

Spencer, White & Prentis, Inc.—"Underpinning," a book by Edmund Astley Prentis and Lazarus White is recognized as the authoritative source for information in the field by engineers, architects and contractors all over the world. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

173 UNI-FORM PANEL SYSTEM

Universal Form Clamp Co.—A 32-page catalog illustrates and describes the Uni-Form panel system of concrete forming.

THE FOUNDATION COMPANY

Half a century of Engineered Construction

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- Industrial Plants
- Bridges
- Dry Docks
- Shipways
- Terminals
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THE FOUNDATION COMPANY

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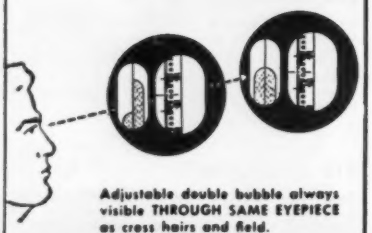
SURVEYORS!

Save time

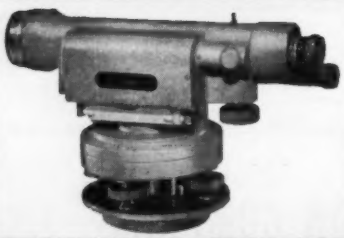
Save money

NEW LEVEL with



Adjustable double bubble always visible THROUGH SAME EYEPIECE as cross hairs and field.

DOUBLE BUBBLE



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- Unbelievably fast and accurate, yet simple-to-use. Economical!

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Please send me Booklet A with information on Fennel . . .

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☐ Other levels ☐ Collimators
☐ Transits ☐ Stands
☐ Combinations ☐ Tripods
☐ Theodolites ☐ Repair of present instruments, (any make)

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ADDRESS.....

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CATALOG DIGESTS

174 UPWARD-ACTING DOORS

The Kinnear Manufacturing Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 88, it gives information on installation clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

175 VALVES

The Ludlow Valve Manufacturing Co., Inc.—A 36-page colored bulletin, completely indexed and well illustrated, describes double disc parallel seat waterworks gate valves. Bevel gearing, valve-mounted motor operators, square bottom valves and tapping machine sleeves are also described. A selection chart of water works valves for municipal services for sizes, pressures, types and end connections is also included.

176 VALVES

Lunkenheimer Co.—Catalog 53 describes in detail the company's complete line of valves, lubricating devices, cocks, and specialties. The catalog, which is indexed and bound, includes engineering reference data and a guide for selecting valves, boiler mountings, and lubricating devices.

Turn to page 134 and order your literature.

177 VANE SHEAR TEST KIT

Acker Drill Co., Inc.—Acker Bulletin 700 describes a new vane shear test kit for obtaining in place soil shear strengths. Kit includes a complete set of attachments for making shear investigations to 100 ft depths in 2½, 3 or 4-casing pipe.

178 VERTICAL DRILLS

The Salem Tool Company—A four-page, two-color brochure explains the new heavy-duty drill Model 106–24 which is a companion drill to the 106–8. The vertical drills meet the requirements of weight, ruggedness, ease of operation, and versatility, and may be used in highway and turnpike construction, seismograph work, strip mine operation and stabilizing hillsides and dams. A specifications chart is included.

179 VERTICAL WATER WELL

Ranney Method Water Supplies, Inc.—The newest development in the vertical waterwell field is the subject of a new brochure. Called the Vertube, it is a natural gravel vertical water well, designed exclusively for low volume users, at low cost. A diagram of the well completes the brochure.

180 WALL CONSTRUCTION

Manu-Mine Research & Development Co.—A revolutionary method of wall construction designed and patented by this company is explained in a 10-page colored folder. The contents include: the method of construction, equipment necessary, and advantages of manu-crete construction.

McCARTHY DRILLS

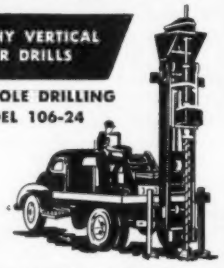
McCARTHY TRENCH OR TUNNEL TYPE HORIZONTAL DRILL

DRILLS UNDER HIGHWAYS, RAILROADS, ETC.

A utility money-maker! Drills through rock or earth for drainage, conduit, pipe lines, etc., without breaking the surface. Drills 4" to 24" holes up to 180 ft. long in hardpan, compacted sand, gravel and shale formations. Send for Bulletin.

McCARTHY VERTICAL AUGER DRILLS

BLAST HOLE DRILLING
MODEL 106-24



Drills dry holes 3" to 24" in diameter. For blasting jobs, prospecting, foundation boring, earth sampling, dewatering operations. Send for Bulletin No. M-100.

SALEM

THE SALEM TOOL COMPANY
804 S. ELLSWORTH AVE.
SALEM, OHIO

UNIQUE RECLAMATION OF WASTES

Earp Thomas Digestors will convert sewage, farm wastes and garbage by continuous flow into black granular humus; then into complete organic fertilizer.

Manufactured by A. O. Smith Corp., these digestors can supply up to 50 tons daily capacity. Pilot demonstrations in this country indicate extensive earnings from processed wastes. Endorsed by scientists, colleges and engineers.

Digestors operated daily in foreign countries produce high quality fertilizer containing valuable factors made by rapid propagation of selected bacteria.

Agents wanted to sell bacterial activators and digestors.

Write for illustrated pamphlets and information to:

EARP THOMAS LABORATORIES
Dept. C-2
Hampton, New Jersey

CATALOG DIGESTS

181 WATER, SEWAGE, AND WASTE

B-I-F Industries, Inc.—A 24-page, 2-color booklet, Bulletin B-I-F 6 offers a complete line of products for the treatment of water, sewage and waste. The products offered include meters and instruments, feeders processes equipment, controls, and filters and filter operating equipment.

182 WATER AND SEWAGE WORKS

The Master Builders Co.—A 20-page booklet contains owner's reports and photographs on the present condition of 15 to 20-yr old concrete in a number of water and sewage plants where Pozzolith was used. The booklet tells how Pozzolith enables engineers to improve concrete quality in all types of construction, by providing the lowest possible unit of water content, control of air-entrainment, and rate of hardening.

There are 193 Digest items on pages numbered 134 to 160. Read all items for the literature of interest to you.

183 WATERSTOPS

Water Seals, Inc.—A colorful eight-page brochure illustrating a complete line of waterstops along with the particular job application of each is available. Polyvinyl waterstops are flexible enough to withstand extreme joint separation, yet are rigid enough to stand up to the battering effect of pouring concrete. The stops are unaffected by acid, alkalies, petroleum products, chemicals or adverse atmospheric conditions and will not rust, rot, check or crack.

184 WATER SUPPLIES

Ranney Method Water Supplies, Inc.—The Ranney collector, infiltration gallery, and new vertube well are fully described and diagrammed in a four-page folder. These various methods provide a water program for every community, industry and budget. A list of foreign representatives is included.

185 WEDGE TENSIONING UNIT

Truсson Steel Division—An eight-page folder describes a new positive wedge anchorage developed for Stressteel bars for use in prestressed concrete construction. The contents include specifications, construction procedures, materials and manhour requirements.

186 WELLPOINT DEWATERING

Griffin Wellpoint Corporation—"The Wellpoint System in Principle and Practice" is a handbook of the fundamentals of wellpoint dewatering and is applicable to any wellpoint system regardless of manufacture. This handbook contains information on how a wellpoint system functions, and methods of planning, layout, installation and removal of the system. The manual is pocket size, 109 pp in length and contains 62 diagrams and illustrations. The price is $1.50.

N. B. There is a charge for this book. Make checks payable to Griffin Wellpoint Corporation.

Problem: how to map bedrock under New York's swift busy East River

Consolidated Edison Co. of New York wanted to lay cable under New York's East River, in a permanent trench safe from all possible disturbance. Question: would bedrock be encountered and if so, what was its profile? The East River is a swift narrow tide-rip carrying some of the world's heaviest marine traffic. Yet a Gahagan Seismic Survey Crew obtained an answer in just eight working days. For the design engineer, Gahagan seismic surveys save time and money, provide a wealth of information about the subsurface (on land or under water) in construction of highways, bridges, dams, power plants, etc. Write for Bulletin 2, Geophysical Survey Division, Gahagan Dredging Corporation, 90 Broad St., New York 4, N. Y.

Established in 1898, Gahagan is a leader in hydraulic dredging

ANOTHER
GAHAGAN
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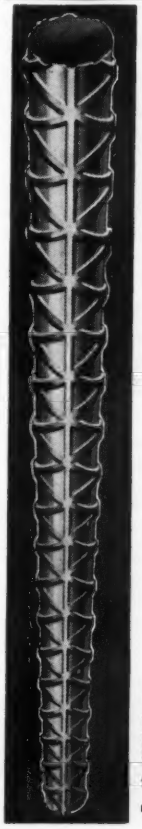

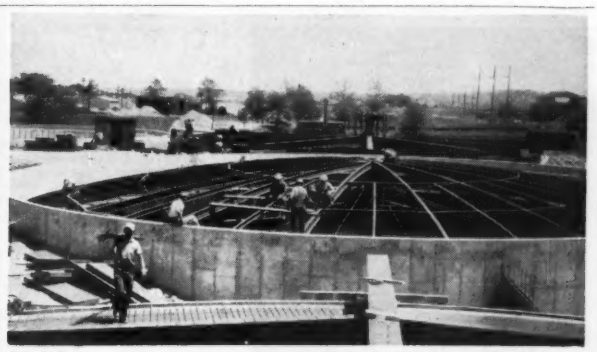

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902. Discussion of Proceedings Papers 241, 424, 458, 720. (AT) No closure to 241. W. J. Turnbull and O. B. Ray closure to 424. G. S. Anderson, and G. McFadden closure to 458. R. H. Williams, J. F. Redus on 720.

903. Discussion of Proceedings Papers 461, 462, 705, 706, 708, 728, 788. (IR) H. M. Ismail closure to 461. No closure to 462. H. E. Thomas, C. E. Busby, P. H. Berg, J. C. Alexander on 705. H. E. Thomas, F. B. Clendenen on 706. Correction to 708. D. C. Muckel, C. C. Warnick, N. Szalay, C. W. Lauritzen on 728. W. M. Borland and C. R. Miller, and S. Leliavsky on 788.

904. Discussion of Proceedings Papers 696, 697, 700, 737, 739, 741, 742. (PO) M. D. Copen, A. W. Simonds, J. T. Richardson, A. C. Xerez on 696. R. F. Krafft on 697. J. L. Serafim on 700. G. B. Woodruff, J. Feld, W. W. Moore, G. L. Jordy on 737. R. N. Brudenell on 739. E. W. Vaughan, S. N. Nicolaou, W. R. Martin, Jr., and J. A. Veltrop, and M. L. Pei on 741. A. Hrennikoff, J. L. Serafim, S. Leliavksy on 742.

905. Discussion of Proceedings Papers 591, 685, 687. (SA) No closure to 591. T. R. Camp closure to 685. J. E. McKee on 687.

906. Old River Diversion Control: The General Problem, by John R. Hardin. (WW) The history of major Mississippi River diversions is presented, the development of the problem of the diversion of the Mississippi River flow through Old River and the Atchafalaya River is traced, and an analysis is made of the observations and studies leading to the conclusion that diversion of the Mississippi River through the Atchafalaya River is imminent.

907. Old River Diversion Control: Hydraulic Requirements, by E. A. Graves. (WW) The streams and floodways of the area form a complex system. Observed and planned discharges illustrate the magnitudes involved. The control of Old River has become necessary because of the threat that the Mississippi River will adopt the course of the Atchafalaya River. An unusual situation exists with respect to the determination of prevailing and prospective tailwater conditions. The expected discharges through the structures are compared with natural flows.

908. Old River Diversion Control: Foundation Design, by W. J. Turnbull and W. G. Shockley. (WW) General geology and soils conditions are presented for the low-sill, overburden control and navigation lock structure proposed for the diversion control of Old River. A detailed description of soil properties and foundation conditions is given for the low-sill structure. Important foundation design features of this structure are discussed.

909. Old River Diversion Control: Structures Required, by Norman R. Moore. (WW) Positive control of Mississippi River flow diversion into the Atchafalaya Basin through Old River requires provision of structures permitting retention of the adopted flood control plan. A lock must also be provided to meet navigation requirements. Planning and design of the structures and appurtenances are described.

910. The Design Wave in Shallow Water, by R. L. Wiegel and K. E. Beebe. (WW) A discussion is presented of the prediction of forces exerted by ocean waves on piles where the wave height is limited by the depth of water (a breaker). Laboratory data are presented which show that a modified solitary wave theory predicts the velocity profile under the crest of a breaker with a standard deviation of 27%.

911. A Ripple Tank Study of Wave Refraction, by G. C. Ralls, Jr. (WW) Refraction of uniform waves on a beach of constant slope was studied in a ripple tank and found to verify Snell's law for wave refraction. The law was verified in this study by analyzing photographic records of wave refraction on a model beach. Both the beach slope and the angle of orientation of the wave train were varied in the investigation.

912. Destruction of Wave Energy by Vertical Walls, by Per Bruun. (WW) Wave energy can be destroyed or affected in different ways by: diffraction, refraction, reflection, breaking, resonance, friction, permeability, special hydraulic arrangements as stilling basins and berms, and by air entrainment. In the paper a summary is given of different methods of destroying or affecting wave energy.

913. Discussion of Proceedings Papers 503, 611, 612, 727, 801, 803. (WW) C. Renshaw closure to 503. N. Chien closure to 611. G. H. Matthes closure to 612. Z. Levinton on 727. G. M. Allen, Jr., on 801. E. Kuiper on 803.

914. Influence Lines for Reactions of Continuous Trusses, by Andrew John Pyka. (ST) The writer, in his experience in bridge design, has sought simplifications in the various methods of obtaining influence lines for reactions of continuous trusses. A procedure known as the "Analogous Cantilevered Truss Method" has been developed which embraces the principles of internal and external work as produced by a one-pound load applied at the end of the structure after all reactions are removed and the truss

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915. Arching Action Theory of Masonry Walls, by E. L. McDowell, K. E. McKee, and E. Sevin. (ST) The arching action theory of masonry walls proposed in this paper represents a radical departure from the resistance to lateral forces usually assumed for this type of construction. The proposed theory is offered as one means of explaining and predicting the relatively great strength of masonry walls constrained between essentially rigid supports. Comparison is made with the available test data on lateral loading of brick beams.

916. Analysis of Collar Slabs for Shells of Revolution, by Gunhard Oravas. (ST) Shells of revolution find wide application as surface carrying structures spanning large unobstructed areas with considerable weight-strength economy of the structure. Very often these shells are extended beyond their boundaries by rotationally symmetrical collar slabs. A typical structure of this kind is analyzed in this paper by a method of successive approximations.

917. Heavy and Tall Building Problems in Mexico City by Leonardo Zeevaert. (ST) Heavy and tall buildings in Mexico City create special problems in foundation engineering and structural design because of the difficult subsoil conditions and earthquakes. This paper cites the problems that arise in the design of the foundation for heavy and tall building in Mexico City and in order to illustrate the general philosophy of design, at the end of the paper two specific cases of foundations designed by the author for two important buildings in Mexico City are presented.

918. Effects of Nuclear Reactor Radiations on Structural Materials, by Ira F. Zartman. (ST) The different types of the nuclear radiations to which materials used in the construction of nuclear reactors are exposed is discussed. Conditions imposed by functional requirements are considered. The effects of nuclear radiations on the mechanical and physical properties of structural materials, experimental results, and basic effects are considered.

919. Behavior of Shock Waves Entering Model Bomb Shelters, by B. B. Dunne and Benedict Cassen. (ST) The use of a spark shadowgraph with effective exposure time of a fraction of a microsecond has enabled very sharp pictures to be obtained of the time sequence of shock wave advance, reflection, diffraction, and turbulent breakup in models placed in a 4 × 4 inch square cross section shock tube. The equipment has been used to gain considerable information on the penetration of shock waves into model shelters. The production and behavior of strong vortices in the models indicate that they should be considered as a full-scale factor in effects on personnel.

920. Tests on Bolted Connections in Light Gage Steel, by George Winter. (ST) Results are summarized of 574 tests on bolted connections in light-gage steel, covering considerable ranges of the pertinent variables such as bolt diameter, sheet thickness, mechanical properties of sheet and bolt steels, edge distance, etc. Four conditions are formulated for predicting failure loads which are in satisfactory agreement with test values. It is shown that if an adequate safety factor is applied to these four conditions, joint deformations at design loads can be held to reasonably small values.

921. Professional Aspects of Surveying and Mapping: Report of the Task Committee on the Status of Surveying and Mapping. (SU) This paper is a report on the professional status of persons engaged in surveying and mapping. Included is a chart of the six surveying and mapping categories, in which the operations are classified as to whether they be professional, pre-professional, or technician level. This is the first phase of a continuing study by a Task Committee on the status of surveying and mapping.

922. Progress in Topographic Mapping from 1946 to 1955, by Gerald FitzGerald. (SU) Scientific and engineering research applied to the procedures for constructing topographic maps since World War II has resulted in the development of new instruments, new photogrammetric equipment and more efficient production methods and techniques. In this period, the cost of mapping has been greatly reduced and with the increased funds available, the output of topographic quadrangle maps has increased about seven times. Although only 37% of the United States is adequately mapped at the present time, at the current rate complete topographic quadrangle map coverage of the country could be accomplished in approximately 17 years at a cost of about $220,000,000.

923. Surveying and Mapping for the Air Force Academy, by Edward A. Merrill. (SU) The problem of master planning and design of a major installation on a complicated site must be based on adequate knowledge of the topography. A description of the procedures utilized with illustrations showing the site, the characteristics of which influenced these procedures, and typical maps developed for use.

924. Discussion of Proceedings Papers 539, 560, 649, 659, 680, 684, 733, 763, 764, 809, 825. (ST) H. C. S. Thom closure to 539. A. F. Diwan closure to 560. W. E. Hanson and W. F. Wiley closure to 649. J. R. Fuller closure to 659. R. Schjodt closure to 680. A. E. Komendant closure to 684. No closure to 733. W. Weleff on 763. I. Z. Sobotka on 764. I. Martin, Associacao Brasileira de Cimento Portland, H. G. Lorsch, L. A. North, and C. F. Long on 809. Corrections to 825.

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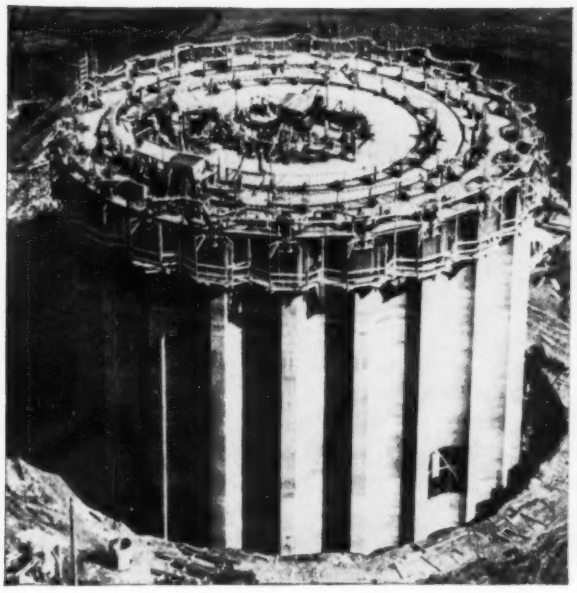

Left: View of the four tower cylinders under construction, with slip-form platform at top.

Right: Wire-winding machine wraps finished tank in pre-stressing operation.

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